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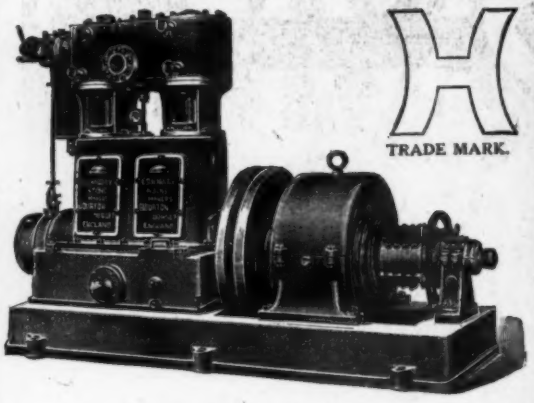

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LONDON'S ELECTRICITY SUPPLY PROBLEM.

FOR the first time in the history of the electricity supply of London, the Supply Undertakers are faced with the absolute necessity of doing something towards providing bulk supply. For over 20 years the question has been discussed *ad nauseam*, and all these years the only action which the supply undertakings as a whole apparently felt themselves called upon to take was that of mutually cancelling each others' efforts, or those of any outsider, and even of the L.C.C. itself. This venerable dilettantism was last week pulled up short by the Electricity Commissioners. Following the procedure of those 20 years the undertakings still apparently relied upon traditional obstructionism as the attitude to adopt towards any new proposal. For the first time they have been clearly told that they will not be listened to unless they offer a constructive plan better than the one they oppose.

The occasion upon which this crux occurred was in itself a very simple one. It was the "hearing" by the Electricity Commissioners of the application of the County of London Electric Supply Co., Ltd., for permission to erect a large generating station at Barking, in order to meet the needs of that company's own big area and in course of time to supplant its present limited generating stations. The company's consulting engineers, with a view to falling-in with the larger London problems, showed on the plans they submitted that such a station could be developed, if thought fit, to any size up to 600,000 KW.; but this, of course, was not part of the present application. All the company asked for at present was to be allowed to go ahead and put up a station for its own needs (about 60,000 KW.), claiming that unless it did so immediately it would be impossible for it to carry on its business. Against this proposal came the opposition of the London County Council, municipal undertakings, and most of the London companies, on the ground that the Commissioners should leave the matter over until March 31st, which was the date for submitting formal schemes for benefiting the London supply under the 1919 Act.

The Commissioners, having apparently in mind the possible resuscitation of ancient linking-up proposals, asked whether there would be any guarantee that March 31st would see a scheme on foot for a bulk supply station with such financial backing as would enable a start to be made at once. The evidence brought forward was very unpromising, and certainly nothing could have been more doubtful than whether the proper finance would be forthcoming. Up to the present no financial proposition has been formulated, much less agreed to, by all the companies and local authorities. The question before the meeting was, therefore, whether six months' delay was justifiable with only such an amorphous project in prospect. On the other hand, the County of London Co. said: "We have a site the suitability of which is assured by its having been chosen time after time by independent people, including the London County Council itself. We have the money; we

have the plans, drawn up by some of the best consultants in the world; and we can go ahead the moment the Electricity Commissioners give their consent. And further, we are willing for the Commissioners to make their consent conditional upon whatever terms they think fit as to handing over the station at any time to any Joint Electricity Authority that shall be formed."

The Commissioners, therefore, have a somewhat awkward case to adjudicate upon. On the one hand, there is the chance of a bulk supply station being put in hand without a moment's delay and without any expense to them at all, and under an undertaking that whenever the Commissioners desired it, such station could be handed over to any other authority. On the other hand, they have the opposition of certain London companies and municipal undertakings, without, however, any guaranteed programme as an alternative.

The Electricity Commissioners gave the municipal undertakings and opposing companies the fullest encouragement to promise to put forward a constructive alternative scheme, and the fact that such promise of a financially backed scheme for a capital station was not forthcoming seems to indicate most indubitably that the same disintegrating factors are at work which have prevented any joint scheme being put forward during all these 20 years. In other words, the undertakings of London generally have not yet learned the lesson of sinking their differences. The real point, therefore, before the Commissioners is whether they are willing to lose the chance of a bulk station being immediately put in hand (which can afterwards be extended into a capital station if they so wish), on the sporting chance of unanimity being reached in the next six months between the disputing local authorities and other undertakings, and not only unanimity, but such mutual confidence as will lead them to back their joint project with hard cash.

WORK AND WAGES.

We hold it to be the bounden duty of every man who has the interests of the nation at heart to preach a gospel—a gospel of salvation by work. Not as a substitute for or as an alternative to the gospel of the Galilean—this, too, has its lessons for industry, but the gospel of salvation by work is supplementary to it from the economic side, and not in conflict with that teaching. We may pray "Give us this day our daily bread," but can we reasonably expect to receive it without effort? "He who will not labour, neither shall he eat." We may lay this down as a determination in human government, but, do that as we may, behind human government there lies relentless Nature which will leave us to starve. "Seed time and harvest shall not fail," but what are these but the seasons for work—for sowing and for reaping? Heaven has always been faithful in making provision for the wants of the human race when men have first done their part—co-operation with Nature is one of the most elementary rules of life. Disobey it *en masse* and we cease existence.

We are not writing lines in our school-room copy books, simple and childish as our words may seem. Nor have we been re-reading the essays of Carlyle on the duty and the glory of work, though a million workers might do worse to-day than study his injunctions to "Produce! Produce!!" We are merely suggesting to our readers that minds are being confused with so many things in these enlightened days that we are overlooking a simple foundation truth, namely, that the vast majority of us can only live because we labour, can only have more because we work harder or more efficiently, can only as communities get out of our work the product that it yields. All our quarrelling about better distribution will not produce one atom more for any of us; indeed, it dissipates our energies and reduces our productive capacity, making the whole world poorer at a time when it has need of every man's full effort. It is not suggested that better distribution is not a legitimate subject for discussion, but we would emphatically say that too often in our conferences we are guilty of fiddling while "Rome" (our industry) is burning. History will assuredly record, as Carlyle did, that we are "mostly fools."

The gospel that every man in his senses should be preaching among his fellows, whatever his calling may be, and whether he be a unionist or a non-unionist, a "have" or a "have-not," is this: Human society and the British people can only be saved from disaster, spiritually, morally, and economically, by a strong, united effort, and by a bold determination to abandon our present selfishness and our will to secure a victory over the class to which we do not belong.

The while we engage in struggles to secure better conditions and higher wages and higher prices for our product, we are by those very struggles, and the manner in which we pursue them, making things infinitely worse for the entire nation. We are driving away from our factories the work that is needed in order to pay wages for bread-buying. The colonial and foreign purchasing world judges us by our divisions, considers that we are taking longer to settle seriously to work than are some Continental countries, and being in urgent need, goes where it can secure what it requires at a more reasonable price and in a more reasonable time.

We cannot believe that the industrial workers of the United Kingdom are alive to the true facts of the trade situation abroad, or they would cease fighting and secure the "bone" for the benefit of both classes rather than let another run off with it.

There are evidences that the trade decline is due to cancellation of old orders, to reluctance to place new ones, and to financial inability following upon heavy war expenditure and taxation. Prices have risen partly because higher wages must be paid, and potential purchasers button up their pockets and do without goods. Yet what do we hear? "We recognise that every man in the kingdom could produce more, but why, and for whom, should we do so? Who will take the profit? No! we will decline to do so under the present system." Here we are up against the question of the better distribution of the profits when earned, surely a matter for reasonable and dispassionate argument and negotiation. But if we wait for the settlement of that matter and, until we get it to the extent to which we think we deserve it, decline to produce more, what is going to happen to us? At present, if we add to the wages bill without producing more for those wages, either we draw from the interest on capital, make capital shy and nervous, and stop enterprising development, or the employer passes the increase on to the consumer, and everybody pays, including the man whose wages are higher, and the hundreds of thousands of others who cannot get more and are on the verge of poverty or deeply in it already; alternatively we go without, demand falls, and unemployment grows.

It is impossible to say to what extent the present trade decline is attributable to this or that particular cause, from among those named above, but it is indisputable that the position will only be made worse by adding to the manifold causes that of increasing the nervousness of many thousands of manufacturers out of whom we have taken the heart. The situation is such that all the enterprise and initiative that British manufacturers and traders possess ought to have the freest possible scope; yet what in actual fact do we find? Where there is eagerness to exercise those business qualities, the continued unsettlement amongst us stands right across the path. Not only are they prevented from displaying the necessary spirit of enterprise, but the uncertainty with regard to prices, and the unwillingness of the workers to give

better output, are preventing them from carrying on ordinary business. They feel compelled to insert fluctuation clauses in their tenders and contracts, and these are conditions that the buyer abroad abominates. At the present time he is wondering what is the matter with Britain when its manufacturers cannot make a firm quotation or promise better deliveries. He thinks more definitely to our disadvantage, and acts against us, when he finds such undesirable clauses missing from American and other foreign offers.

There is one aspect more of our present problems that we are moved to mention. At the present time the success of one section of organised workers in obtaining higher wages is crushing the heart out of hundreds of thousands in other classes of workers. Instead of being out to help the "under-dog" generally, they are lifting themselves partly at the expense of that under-dog who cannot improve his position. They are also throwing some of their fellows of equal status with themselves right out of employment because they have raised their own wages. Good wages for some and no wages for others—only unemployment pay—is likely to be the inevitable consequence of overdoing demands and restricting industrial and trade development. A substitute for this, where workable, finds three or four days' work for all instead of full work for some and none for the rest. Standing charges thus spread themselves over a limited output, and the cost of the individual article cannot possibly be reduced. Another point of note in this connection may be selected for mention. The unwillingness to give reasonable output in some branches of industry is having upon producing operations the same kind of effect that the moulders' strike had upon various branches of the engineering trade. Workers who are engaged in producing what comes under the comprehensive title of "raw material" are unwilling to give the required output, and there is in consequence a shortage of parts. One effect has been that even works which have no lack of orders on the books have had to discharge men because operations are held up.

How urgent would seem to be the need for us to learn afresh the truth that we are all in a measure interdependent. The solidarity of labour is a beautiful expression, but at present it is a theory and a theory only. There is a scramble in progress in which some of its sections are groaning under the increasing burden crushingly imposed upon them by others.

Long-Distance Transmission.

We recently described at considerable length a new method developed by M. P. Bunet* for the transmission of electrical energy over extra-long distances, making use of the properties of electrical resonance. As we remarked at the time, there is no likelihood of such a method finding application in this country, but it may be found of great value abroad.

Barely a month since we completed the publication of the article, we learn that a project for the transmission of electricity from the Kroonstad Colliery to the diamond fields of Kimberley is under consideration; the distance from the generating station to the furthest point of supply is said to be 300 miles, and therefore is practically identical with the case discussed on pp. 316-7 of our issue of September 3rd. Particulars of the scheme appear in our "Notes" columns to-day.

Our information with regard to the circumstances is not sufficient to enable us to enter into the matter in detail, or to judge whether the conditions are favourable to the use of the Bunet system; but it is certain that in planning a transmission over so great a distance, every possible means of reducing the cost, increasing efficiency, and improving regulation will have to be sedulously explored, and we have no doubt that the merits of the Bunet system will be carefully weighed before any steps are taken to realise the project. It will be remembered that with half-wave transmission the generating and receiving plant is of the ordinary standard constant-pressure type, and it is only in the design of the line that departures from current practice arise. It is not only in South Africa that extra-long-distance transmissions will be called for; but in that vast area there already exist great industries requiring power, and great natural sources of power remote from those industries, with which they should be linked. Some day the resources of the Victoria Falls on the Zambesi River, which it was proposed to tap with a 700-mile line years ago, will be drawn upon, and we may yet see a great trunk line across South Africa electrically vibrating like a gigantic violin string.

* Electrical Review, August 13th—27th, and September 3rd, 1920.

Gasfilled v. Half-Watt.

A correspondent recently pointed out that vacuum tungsten lamps closely resembling gasfilled lamps were on the market, whilst another drew attention to the impropriety of describing certain new types as "half-watt" lamps, simply because they were gasfilled and of similar construction to their fore-runners. Both these points demand the serious consideration of the lamp-makers and dealers, as well as of the consumer.

It is imperatively necessary that electrical apparatus of all kinds shall be described in terms corresponding strictly to their true merits; this is the only course according to the principles of common honesty—perhaps we should not say "common," as we may be told that honesty is uncommon—and for the benefit of those to whom this argument does not appeal, we may add that a false description inevitably brings its just reward in the long run. In the case in question, a simple solution would be found by wholly abandoning the use of the term "half-watt" and adopting "gasfilled" as the distinctive name of all high-efficiency incandescent lamps filled with inert gas. The process of substitution would take some time, but it is worth doing, and if the lamp-makers were to make a special point of drawing attention to the matter in their catalogues and advertisements, it would be greatly accelerated.

The E.P.E.A. and the E.T.U.

Now that the turmoil is over, and peace reigns in the electrical industry, it seems to us undesirable to continue to discuss the circumstances and events which attended its course. Nevertheless, justice must be done, though the heavens fall, and misconceptions must be cleared away, for which purposes we desire briefly to recur to the subject of the dispute.

In the first place, in the light of greater knowledge of the facts, we wish to bear witness to the sincerity and earnestness of the E.P.E.A. Executive in the pursuit of our common aim—industrial peace. We are now convinced that that was the sole motive which actuated its members, and that their action was not dictated by slavish adherence to a formula, as we had been led to suppose (mainly by official statements). During the fateful week when the cloud was hanging over London, they put forth strenuous efforts to avert the threatened storm, and we have no doubt that it was very largely—perhaps, mainly—due to their exertions that a peaceful solution was attained.

With regard to the merits of the original dispute, and the undesirability of entangling the industry of public electricity supply in questions which have no bearing upon its conduct, our views are unchanged; they are shared by the District Industrial Council for Electricity Supply, No. 5 Area, which has passed a resolution to the same effect. But in view of certain comments on our attitude which have been made in our own "Correspondence" columns and in other quarters, it is due to ourselves to state emphatically that our opinions are of our own formation, based upon the facts so far as we know them, and entirely uninfluenced from outside. Our correspondents, while questioning our attitude, admit our customary fairness and impartiality, qualities which we prize; we have no axe to grind—the welfare of all classes of the public is our sole aim. Our opinions may not be infallible, but they are honest.

ELECTRICITY SUPPLY DEVELOPMENTS AND NATIONAL FUEL CONSERVATION.*

By L. MARSHALL JOCKEL, A.M.I.Mech.E.

The passage of the recent Electricity (Supply) Bill through its various phases in Parliament appears to have drawn a considerable amount of attention to the super-station idea of generation in this country.

Articles of a semi-technical nature have appeared in the lay Press, and the writer has already heard business men talking quite seriously about vast supplies of cheap electricity for all purposes, now that the "new idea" of super-stations is being recognised in the Government scheme!

These lay ideals of a few super-stations supplying "rivers" of cheap electricity under a nationalised scheme of supply are not yet on the horizon, and for the immediate future we will have to develop our supply schemes upon fairly well-established engineering lines consonant with sound economic principles.

Now that the Electricity (Supply) Bill has become an Act of Parliament, the policy of the Government has become somewhat clearer, and whilst large and up-to-date power houses will be constructed, the cult of the "super-stationists" may become less popular.

In many quarters, however, there is a feeling that the new Act is somewhat short-sighted in its policy, inasmuch as it allows the present system of generation by coal destruction to continue, and may even perpetuate the system on a large scale in the so-called super-stations. It should be remembered, however, that the Electricity Commissioners are to be given a reasonable amount of latitude to carry out or initiate experimental or research work, and no doubt the problem of more efficient generation from coal or other fuels will receive due attention.

It has taken five years of war conditions to drive home some of the most elementary facts in connection with both electricity supply and fuel conservation in this country, whilst judging from recent legislation it may take another five years of peace conditions to inculcate the idea of the inseparability of electric power supply and the conservation of our fuel resources.

Further legislation will be necessary if our national fuel supplies are to be adequately conserved, and the public will require to be educated to the fact that our coal measures are not inexhaustible, that waste is a crime in any civilised community, and that our comparatively old pre-war systems of power supply, heating, and lighting must not be perpetuated.

In the interval which will probably elapse, electricity supply engineers will, it is hoped, be given the facilities so long denied them of "putting their house in order," and if the Electricity Commissioners are freed from political red tape, great progress may be confidently anticipated. The need for adequate supplies of electricity is the pressing problem of the moment, and it is safe to say that thousands of prospective consumers in this country are awaiting supplies for power purposes, but cannot be connected until sufficient plant and cable are put into service, whilst in many undertakings the existing plant has had to be seriously overloaded to cope with the winter peak loads.

It appears almost certain, then, that the present system of generation using coal-fired water-tube boilers and large steam turbines, must be continued in the immediate future or the post-war reconstruction period, although it entails the complete destruction of the coal under the boilers, and an overall thermal efficiency in the region of 20 per cent.

At first sight this appears rather an unprogressive policy, but it must be borne in mind that consumers require energy *now*, and in a very large number of cases electricity is being adopted from an economic point of view, so that considered broadly, national fuel conservation is really being steadily attained. The present urgent demands will thus be met, and should no radical departure from existing methods of generation take place in the near future, it is probable that several of the proposed so-called super-schemes will materialise, and naturally considerable interest is centring around the few large stations which are at present under construction. Whilst these stations will represent the latest practice as regards the employment of large generating units, high steam pressures and total temperatures, with greatly improved designs of extra-high-pressure control gear, no radical change is being made in what is now considered to be almost generally accepted practice. In view of this fact, it seems almost fallacious at this early stage of our progress in generation matters, to apply the term "super-station" to a large up-to-date power station. The writer has it on excellent authority that in the case of one at least of the large new stations still under construction, the initial instalment of plant is already earmarked as regards new consumers' demands, and it has been necessary to proceed at once with what may be regarded as practically a 100 per cent. extension of plant. It is quite possible that within the next five years or so, a considerable number of the supply systems in the more important industrial areas will be able to record an increase of about 100 per cent. in energy sold, so that if the present new stations are called "super-stations," they may have to be termed "super n-stations" in the near future, where "n" is used to denote the index of the super power!

In the meantime, the interest of supply engineers will no doubt be focused upon the stations approaching completion, and when these commence regular steaming, the operating results will probably prove of considerable guidance before most of the proposed new schemes are really well under construction. These new stations will undoubtedly show more efficient results than any of our existing power houses, but it does not necessarily follow that a very great reduction in the total costs per kilowatt-hour sold will result therefrom, owing to the heavy capital charges involved, and in some cases the probability of increased dual-transforming losses, in addition to transmission losses. Indeed, the construction of these large power houses under the present economic conditions in this country is viewed with disfavour by the "anti-super-stationists," who, amongst other reasons, contend that the saving effected in generating costs is insufficient to balance the greatly increased capital charges necessary with the so-called super-station.

This argument is true, of course, in many instances, and an excellent case can then be made out for local generation or an extension of the existing facilities, particularly if the present methods of generation are combined with a fuel conservation scheme, as may be possible in the near future.

Comparisons of the present-day costs of plant and buildings per kilowatt installed, show an increase of from 150 per cent. to even 180 per cent. over pre-war prices, whilst the provision of an up-to-date extra-high-pressure transmission system, and specially designed heavy type control gear, are factors of much increased importance in a large modern power scheme. Owing to the present unstable conditions in industry, it is difficult both to obtain satisfactory estimates for plant and materials, and during construction to adhere closely to original figures, whilst a new scheme involving specially designed plant or extra-high-pressure control gear, is perforce debited with a proportion of what might be fairly described as development or pioneering charges.

Assuming that the many considerations involved are favourable in an existing scheme for the erection of a large station, under the present economic conditions, it is difficult to see how the capital charges can be kept

* This article was written in March, 1920.

below 60 per cent. of the working costs, even assuming a good improvement in the load factor, and a ratio of 70 per cent. is probably more realisable in actual working.

It may be of interest to consider some approximate estimates in connection with the provision of a large waterside power house, designed, say, to cope with the increasing demands for energy in an industrial area already supplied by an existing station, incapable of being economically extended to meet future requirements. The costs are based upon present-day prices, which are somewhat unstable, and the capital costs include foundations, buildings, coal stores, riverside work, all necessary plant and machinery, transformers, and E.H.T. control gear, but the costs of trunk mains and step-down transformers to link up with the existing system, are not included. The station is assumed to have an initial plant capacity of 60,000 kilowatts, but provision is made for easy and economical extension to an ultimate capacity of about 100,000 kilowatts, so that the capital expenditure per initial kilowatt installed is naturally heavier under these conditions. An annual load factor of 50 per cent. is assumed initially, with a maximum load of 40,000 KW., so that the output will be 175 million KW.-hours generated per annum. Three generating sets are provided, each turbo-alternator having a rating of 20,000 KW. at, say, 0.9 P.F., and one set with its accompanying boiler plant being spare or stand-by capacity.

An annual charge of 12½ per cent. on the capital expenditure has been allowed to cover interest and other standing charges, but in view of possible developments during the useful life of the plant, this is probably a rather moderate estimate of the capital charges.

In connection with the working costs, an average coal consumption of 2 lb. per kilowatt-hour generated is assumed, and an overall thermal conversion efficiency of 17 per cent., or stated more conveniently, a thermal economy of 20 B.TH.U. per watt-hour generated. The figures have been calculated on a generating basis for simplicity, so that allowances must be made when considering revenue figures based on the energy actually sold, as no estimates for the transmission and distribution systems have been included. The approximate costs can be briefly set down as follows:—

Capital Expenditure	**£1,500,000**
Annual Capital charges at 12½ %	**£187,500**
Do. do. do. in pence per KW.-hr. generated (On 175 million KW.-hrs.)	**0·2571d.**
Working costs per KW.-hr. generated:— (On 175 million KW.-hrs.)	
Coal cost (at £1·25 per ton)	**0·2678d.**
Other costs	**0·0893d.**
Total ...	**0·3571d.**
Total costs per KW.-hr. generated:—	**0·2571d.**
	0·3571d.
Total ...	**0·6142d.**

In the above estimate the ratio of capital charges to working costs is approximately 72 per cent. on a generating basis, but the ratio will vary considerably in every scheme, and may quite easily be some 80 per cent. of the working costs. The heat consumption figures may appear to be rather heavy for modern steam plant, but they have been increased by an allowance of 10 per cent. to cover possible differences in actual working between the calculated figures and the results obtained over, say, an extended period of working under commercial conditions. The overall efficiency will vary somewhat with the quality of the coal used, and it might almost be said that under present conditions the thermal efficiency of a power station is influenced by such external considerations as the temperament of the miners' leaders, and the effects of State control of the mines! It should, however, be possible to realise an overall conversion efficiency of about 20 per cent. (*i.e.*, say, 17.1 B.TH.U. per watt-hour generated), with up-to-date plant scientifically handled, and a load factor of not less than 50 per cent., with the present quality of coal available for power stations.

In the absence of actual figures, it is difficult to forecast the performance of a large power station either on a technical or a financial basis, more particularly so if the heavier items of plant are built on site, and the "test plate" is their actual foundation in the power house.

It seems desirable at the present time that we should put our old-fashioned methods of compiling technical data and working costs into the melting pot, and re-cast them in up-to-date standard moulds, so that the figures could be used for making reliable comparisons between different supply undertakings. The generation of electricity in power stations is a manufacturing process, the raw material, or coal, being subjected to chemical and thermal treatment in the boiler plant, before its potential energy is transformed, and becomes available in the heat carrier, or steam, which in its thermodynamic cycle gives up a proportion of its energy to the turbine blading.

From fundamental considerations, it seems only logical then that the operating results should be expressed on a thermal basis, and the writer is convinced that in practice this is both a convenient and a satisfactory method of stating results, and one which is applicable to any size of power station. Perhaps, however, this matter will receive official consideration in the present reconstruction period in the history of electricity supply.

Turning now to broader views in connection with the future of electricity generation, it is difficult to forecast developments during the next decade, particularly if national fuel conservation becomes a legally inseparable consideration of electricity supply, as suggested earlier in this article. Whilst hydro-electric power will probably be developed to some extent when capital becomes easier, the generation of electricity by thermal methods either directly or indirectly from coal is certain to continue. Whether the large waterside power house situated outside the area of supply will survive the developments of the next ten years or so, is perhaps a matter of conjecture at present, and there are not a few engineers who are bold enough to assert that the so-called super-station is merely a passing phase in supply history, and that a return will be made to local generation schemes in the interests of heat conservation.

It appears certain that a very substantial increase in the load factor will be necessary in order to minimise the effects of the capital charges involved in connection with the large waterside station, and at present this will be very difficult to secure unless interconnection is possible, to obtain the advantages of a widespread network and a diversity of load. Further, in stations operating with a few large sets of plant, reliability of supply is of paramount importance, as indicated by the writer in an article in the ELECTRICAL REVIEW of March 27th, 1914, and this can only be economically secured in the majority of cases by the interconnection of systems.

Possibly the Electricity Commissioners will initiate, or at least give encouragement to, research in generation matters, and it is quite probable that within a comparatively short time we shall have before us some fairly reliable data in connection with a combined coal carbonisation and electricity generating scheme, in which the capital cost and improvement in lay-out will be on more justifiable grounds than has hitherto been the case. If we assume the adoption of such a scheme in the future, it appears probable that the large steam turbine will be used for generating purposes, owing to its various advantages and further possible improvements in efficiency, which will enable it easily to hold its own when compared with the internal-combustion engine or gas turbine, in the event of these prime movers becoming a commercial success in large units. The boiler plant in connection with the combined carbonisation scheme might be both gas and coke fired, and in this connection perhaps a further development of the Bonecourt boiler may be utilised as regards gas firing.

But with all these schemes there would still be a heavy loss of rejected heat at the lower temperature, which, in the case of steam or fluid turbines, would be some 65 to 70 per cent. of the total heat in the steam or heat carrier. A considerable portion of this rejected heat might easily be utilised in the case of internal-combustion prime movers, but as regards present practice with steam turbines, about 70 per cent. of the total heat in the steam is carried away by the condenser circulating water, and with large modern units some 65 per cent. will probably be dissipated by means of the cooling water.

Assuming, for example, the case of a large waterside station equipped with modern steam turbine plant and carrying a load of, say, 50,000 kilowatts, then under average conditions of working the heat rejected to the condenser circulating water will be from 495 to 500 million B.TH.U. per hour.

The colossal waste of thermal units in the condenser cooling water of large power houses is a problem that may have to be tackled in the immediate future, if the large waterside station is to become more than a passing phase in supply developments, and become a potent factor in a combined scheme of electricity supply and fuel conservation. The rejected heat might be utilised in connection with a public hot-water supply system, as proposed by Mr. W. M. Selvey, and if the power house is at all reasonably situated with regard to the area of the hot-water service, the scheme appears to offer commercial possibilities in respect of fuel conservation.

Vast quantities of heat are necessary for domestic and industrial purposes in any community, and the writer believes that fuel conservation, cheaper and more universal electricity, and a cleaner and healthier atmosphere, are all inter-related problems that will have to be tackled by engineers during the next decade. The relatively small, and at present inefficient power station, situated centrally to its distributing network, will in many instances be superseded by a bulk supply, but there is still scope for the development of combined generating and heat supply schemes, utilising chiefly the rejected heat from the electricity works plant.

The idea of transmitting either hot water or steam to any appreciable distance is often considered to be quite impracticable, but in practice it can be commercially successful, and result in a considerable economy of fuel.

Various estimates of the coal wasted annually for both industrial and domestic purposes have been computed by different authorities, but supposing the very moderate figure of 30 million tons wasted through inefficiency and ignorance, &c., it appears evident that we are still a prodigally wasteful nation. Further, suppose that owing to national fuel conservation, we sold an increasing proportion during the next few years of this 30 million tons per annum in the overseas markets, the revenue obtainable by taxation alone would justify Government assistance for various reconstructional schemes, such as railway electrification, power supply improvements, inland waterways, and transport systems, &c.

The writer is aware that whilst "Utopian" ideas in connection with fuel conservation are easy to construct, they would be difficult to practise during the present period of industrial unrest, but it is very necessary that engineers, and particularly electricity supply engineers, should keep ideals always ahead of their practice, for in a very large measure, progress in both electricity supply and national fuel conservation will depend upon their exertions.

U.S.A. STANDARD PRACTICE IN VOLTAGE RATINGS.*

By F. D. NEWBURY and R. W. E. MOORE.

THIS article has been prepared in order to show the American practice in alternating-current voltages of systems and apparatus, and the reasons leading up to their development and use. While a very great deal has been accomplished in standardising voltages, yet there is a considerable field that has not been covered, but in which there has been established a logical and economic practice. It has been attempted only to cover this subject in a broad and general way.

Early Development of Utilisation Voltages.—In the very early development of the electrical industry, experimental work commonly employed 100 volts, and this value was used on account of limitations in lamp construction. Lamps and other simple devices were constructed for this voltage; also generators were commonly designed for 100 volts. There was, however, a tendency for distributing circuits to increase in voltage due partly to the desire to reduce the effect of voltage drop by increasing the basis voltage, but largely to the influence of the carbon incandescent lamp which, for practical reasons, was supplied to the industry in a wide range of voltages from 100 volts upward. These lamp voltages ranged from 100 to 130 volts, and brought into existence a corresponding range of utilisation circuit voltages. The present practice shows a variation in circuit voltages of from 110 to 120 volts. This condition retarded standardisation for a long period of time, and has made it difficult to accomplish.

The tendency for voltages to increase seems to be universal. Direct-current traction voltages may serve as a typical example. Since 1900, traction voltages have increased from 500 volts to 550 volts, and during the past ten years to 600 volts. This general tendency for voltages to increase as soon as placed into use is mentioned only to indicate the reason for the basis of 110 commonly used, and also to suggest the difficulty of maintaining, for any length of time, a standard based on any lower voltage.

In this connection some statistics may be interesting showing the magnitude of the field covered by the present discussion, and consequently the extent to which these standard practices have become well established.

In a single year (1919) there were 182 million incandescent lamps sold within the United States. There are nearly 6,000 main generating stations in the United States having an aggregate generator rating of nearly thirteen million K.V.A., and representing a capital investment of between 2,500 and 3,000 million dollars (£500,000,000-£600,000,000). This does not include isolated plants, power stations serving only one manufacturing plant, nor the plants operated by electric railway companies for their own power. There are 126 power plants of over 20,000 KW. capacity. The rapid increase in the number of new A.C. generating stations makes this subject of standard A.C. voltages particularly important at the present time. In the United States alone, for example, 226 *new* central stations were built in 1919. Of the central stations (stations generating power to sell) in the United States, nearly 80 per cent. are entirely alternating current, and an additional 10 per cent. are a combination of alternating and direct current. In addition to that given above, there are a very large number of isolated and industrial generating plants as indicated by the census of 1917, which showed 45,000 such plants.

Classes of Systems.—Systems and apparatus, from the standpoint of voltage standardisation, may be conveniently divided into four groups. This division into classes is employed only for the purpose of presenting this subject in the clearest form, and the limiting values employed in each class are not to be considered as representing definite limits in practice.

1. Relatively small systems (up to 1,000 or 2,000 K.V.A.) with voltages up to 2,400, in which generators may be directly connected to the utilisation circuits, or step-down transformers may be used (figs. 1 and 2).

2. Systems of medium size (up to possibly 20,000 K.V.A.) supplying urban communities of medium size, using generator voltages up to and including 13,200, and which may or may not use step-up and step-down transformers between the generators and distribution circuits (fig. 3).

3. Systems of large size (larger than class 2 and up to approximately 100,000 or 200,000 K.V.A.) serving the largest urban communities, or supplying areas of considerable extent by transmission lines, employing voltages up to roughly 88,000, and having step-up and step-down transformers (fig. 4).

4. Large, long-distance, transmission systems employing voltages up to 220,000. From the standpoint of standard voltages, this class is simply an extension of the preceding class (fig. 5).

* This article was prepared in view of the discussion which took place at the last meeting of the I.E.C. with regard to standard pressures.

Values of Normal Circuit Voltages.—The following table gives a somewhat complete list of the values used in practice as the normal voltages for circuits in the several classes of system :—

Class No. 1a **(without distributing transformers).—See Fig. 1.**

Generator voltage.*	Utilisation device voltage.
240	220
480	440
600	550
2,400	2,200

Class No. 1b **(with distributing transformers).—See Fig. 2.**

Generator voltage.*	Utilisation circuit voltage.	Utilisation device voltage.
240	115	110
480	230	220
600	460	440
2,400	575	550

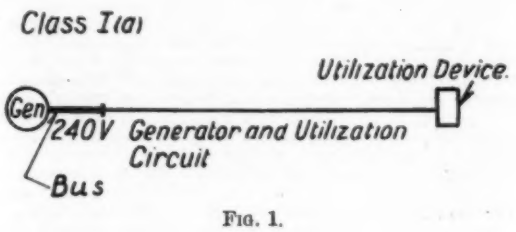

Fig. 1.

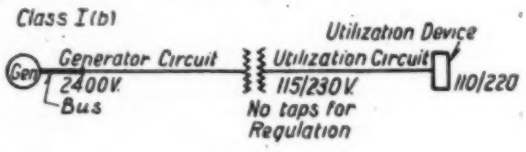

Fig. 2.

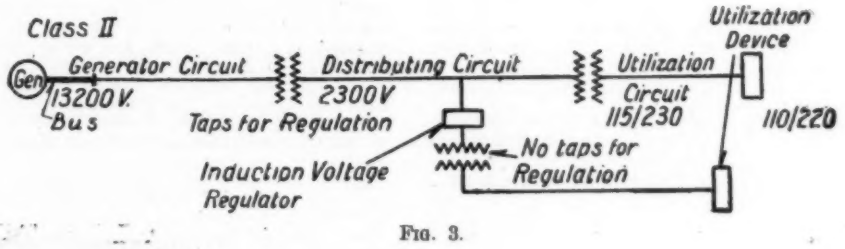

Fig. 3.

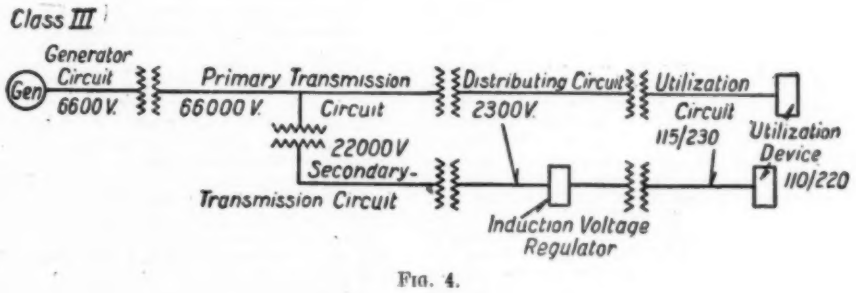

Fig. 4.

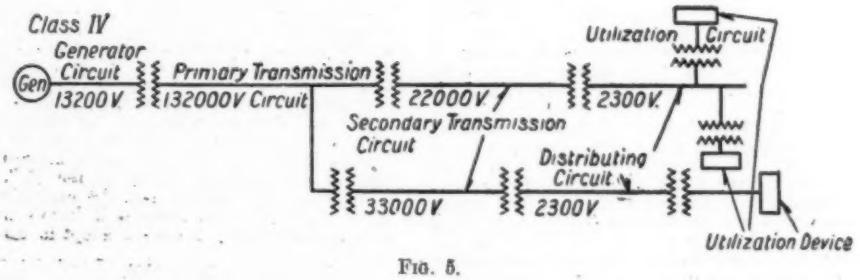

Fig. 5.

Class No. 2.—**See Fig. 3.**

Generator voltage.*	Distributing circuit voltage.	Utilisation circuit voltage.	Utilisation device voltage.
6,600	2,300	115	110
11,000	2,300/4,000 Y	230	220
13,200		460	440
		575	550
		2,300	2,200

Class No. 3.—**See Fig. 4.**

Generator voltage.*	Transmission circuit voltage.	Distribution circuit voltage.	Utilisation circuit.	Utilisation device voltage.
6,600	22,000	2,300	115	110
11,000	33,000	2,300/4,000 Y	230	220
13,200	44,000	6,900	460	440
	66,000	11,500	575	550
	88,000	13,800	2,300	2,200

Class No. 4.—**See Fig. 5.**

Generator voltage.*	Transmission circuit voltage.	Distribution circuit voltage.	Utilisation circuit.	Utilisation device voltage.
6,600	22,000†	2,300	115	110
11,000	33,000†	2,300/4,000 Y	230	220
13,200	110,000	6,900	460	440
	132,000	11,500	575	550
	154,000	13,800	2,300	2,200
	220,000			

† **Secondary transmission circuits.**

The Utilisation Device Voltages given are those which are standard for a very large amount of apparatus using current, especially motors, but there are some devices supplied at other ratings. This is particularly true of lamps.

A word of explanation concerning the terms used in the illustrations of typical systems and in the above tables may be necessary. Circuits may be conveniently divided into four main classes :—

1. The generator circuit is the part of the system from the generator to the station bus. The same voltage value is considered to exist throughout the generator circuit which obviously is the generator voltage, and it is convenient to omit the word "circuit" in referring to the voltage of this part of the system.

2. The transmission circuit is the part of the system in which bulk power is transmitted from one locality to another locality; it is that part of the system between the secondary of the station step-up transformers and the primary of the step-down transformers serving the distribution circuit. The transmission circuit may be divided into primary and secondary transmission circuits when several transmission lines at reduced voltage are tapped off the main or primary transmission circuit.

3. The distributing circuit is that part of the system consisting of the distributing network.

* The generator voltages as given are commonly accepted in the United States as system voltages.

4. The utilisation circuit is that part of the system to which lights, motors, heating apparatus, and other utilisation devices are connected. A distinction is made between the voltage of the utilisation circuit and the voltage of the utilisation device which represents the conventional voltage drop in the utilisation circuit.

Discussion of Class No. 1 Voltages.—It will be noted at once that generator voltages in Class No. 1 are multiples of twelve, while voltages in other classes are multiples of eleven. The reason for this difference is the absence of transformation in the majority of installations employing low voltage generators. Originally it was common practice to adhere to the same ratio in generator voltages as in voltages of other apparatus, and the standard generator voltages were 220, 440, and 1,100, and 2,200. However, as 110 and 220 became better established as the standard voltages, and the requirements concerning uniformity of voltage in utilisation circuits became more exacting, it was found that generators, supplying utilisation circuits without transformers must be designed for higher voltages, to provide for the necessary drop between the generator and the consuming device. The lower voltages, 220 and 440, were the first to be changed to these higher values of 240 and 480, and there was a period when standard generator voltages were 240, 480, and 2,300, but this proved uneconomical from the generator standpoint since it is convenient that the voltages within a given class be whole number multiplies of the basic voltages (in this case 120). Therefore the standard voltages of 240, 480, 600, and 2,400 were finally reached.

Discussion of Voltages of Classes Nos. 2, 3, and 4.—We have pointed out that the development of lamps, motors, and other utilisation devices led to a basic voltage of 110. This, in turn, determined the common factor of eleven used throughout American practice for transmission, distribution and utilisation circuits.

There is an apparent discrepancy between the voltages recommended for generators (240, 480, and 2,400) and the corresponding voltages recommended for distribution circuits from transformers (230, 460, and 2,300). Utilisation devices of the same voltage may be supplied directly from both of these voltage sources. These differences arise from the different conditions existing in the two cases.

1. There is more freedom in the choice of transformer locations with reference to the centre of the load than in the case of generators, so that the permissible voltage drop between the generator and its load should be greater than between the distributing transformer and its load.

2. Transformers may be designed (as is the case in U.S. practice) to operate successfully within a moderate range beyond their rated voltage, while generators cannot be provided with this voltage margin, without providing equal percentage increase in capacity. This also makes it possible to provide satisfactory voltage at the utilisation device with the lower transformer secondary voltage.

Generators inherently have a fixed maximum voltage at the maximum rated load and rated power factor because of the fixed exciting voltage and a higher voltage cannot be maintained unless the excitation voltage is increased above its normal value. It is logical, therefore, to consider the station bus voltage as establishing the system voltage. In systems having step-up transformers connected to the station bus, the ratio of transformation establishes the normal voltage of that part of the transmission system. Several secondary transmission or distributing circuits of varying length and density of loading may be tapped off from this primary transmission circuit, each having its own load drop and other service requirements. It has, therefore, become standard practice to provide transformer taps in the step-down transformers. The ratio of transformation in the step-down transformers, therefore, establishes the normal voltage of the distributing circuits.

It will also be noted that while the common divisor of voltages for transmission circuits is 11 (22,000, 33,000, &c.), the corresponding factor for distributing circuit voltages is 11.5 (2,300, 6,900, &c.).

It is American practice to design distributing transformers (up to 6,900 volts) feeding the utilisation circuits, without voltage taps for reasons of manufacturing economy. This makes it desirable to provide for a large part of the total voltage drop of the system at the point in the system where taps are available ahead the distributing transformer. This is the reason for the higher basic voltage (115 instead of 110) in the distributing circuit, as compared with the basic voltage in transmission circuits.

Normal Value of Line Drop.—It will be noted that the total difference between the generator or secondary voltage of the step-up station transformers and the utilisation voltage, is based on approximately 10 per cent. line drop. This value is subject to variations in practice, but 10 per cent. represents, according to the American experience, a fair compromise between reasonable cost and good service. It also represents a compromise based on practice that embraces the widest possible variety of condition in cost of power, from one extreme of high-priced coal or oil to the other extreme of water power; and a wide variety in service requirements, ranging from large congested city conditions to transmission systems hundreds of miles in extent. It is to be understood that closer regulation is obtained, when desired, as in city lighting circuits by the liberal use of induction-type feeder regulators, or on transmission circuits by synchronous condensers.

Normal Voltage of Circuits.—There is another question that inevitably arises in any discussion of standard voltages. What is the normal voltage of the circuit? Voltages of widely different values exist in the same circuit in many practical cases due to line drop, or in the case of long transmission lines with high capacities, the voltage at the receiving end of the circuit may be higher under light load conditions, necessitating a reduction in the voltage at the generating station, or the equivalent to maintaining normal voltages at load centres. Engineering considerations of insulation margin of safety make it necessary to consider the *highest* rated voltage of any apparatus connected to the circuit as the normal rated voltage of the circuit. Then all apparatus that is to be connected to the circuit should be designed to have the recognised standard margin of safety based on this normal rated voltage of the circuit, even if, under usual operating conditions, a particular piece of apparatus is connected to a part of the circuit that operates at a lower voltage than the normal voltage of the circuit under same load conditions.

The practice has developed, in view of these considerations, of defining the normal voltage of the system in the following terms. This definition and practice has been suggested for general adoption:—

"In systems employing transformers, the normal voltage of the system or circuit is defined as the highest rated voltage of the secondaries of transformers supplying the system or circuit. This voltage rating applies to all parts of that particular system of circuit.

"It is to be understood that the standard rules for dielectric strength tests be based on the *normal* voltage of the system or circuit as defined above, and all dielectric strength tests shall be based on the normal voltage of the system, even if apparatus is applied on a part of the system which ordinarily operated somewhat below the normal voltage."

This definition of normal voltage is intended for application to all systems. Any definition of normal voltage of the circuit that is not based on the highest voltage existing normally in the circuit is, in effect, a reduction in the recognised margin of safety of the insulation, and rather than accomplish such a reduction in margin of safety indirectly in this way, it would seem preferable to do it directly by changing the standard dielectric test rules. But the tendency in connection with the rules for dielectric strength seems to be in the direction of increasing the margin of safety rather than decreasing it.

CORRESPONDENCE.

Letters received by us after 5 P.M. on Tuesday cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Economiser Tubes.

Would any of your readers show by diagrams and explain an easy and quick method of withdrawing and replacing economiser tubes (Green's)?

R. S. Thornthwaite.

Whitehaven, *October 5th*, 1920.

The E.P.E.A. and the E.T.U.

I am very pleased to find someone upholding the attitude taken by the E.P.E.A. in the recent electrical industry dispute.

May I ask why so many of your correspondents—and yourself, judging by your footnote appended to a letter signed "Pollux" in this week's Electrical Review—are so convinced that the E.T.U. set out to "nobble" the E.P.E.A.? It is very evident from previous letters on the subject that, between certain sections of these unions, rather bad feeling exists, and it would appear—to my mind—that someone (most probably an enemy of both) is trying to work that "rather bad feeling" into a feud to serve his ends. Who can it be that is the common enemy of the E.T.U. and E.P.E.A.? Most probably, I should say, the capitalists, but the support given to this in your footnote is hardly in keeping with the impartial attitude you usually adopt in these matters.

Juice.

London, *October 10th*, 1920.

Having read the correspondence that has appeared in your columns lately on the subject of the E.T.U. and E.P.E.A. and noted the one-sided tendency manifested therein, I was relieved to find something on the other side in the letter signed "Pollux" in this week's Electrical Review. I will lay myself open to being accused also of being "naive" and "artless" by endorsing his remarks.

Your own lengthy remarks and comments on the letter in question are, however, somewhat mystifying to me, for I cannot decide in my own mind whether you have an axe to grind, or have only taken (to an E.P.E.A.-ite) a wrong view. Whatever the cause, the letter appears to have "hit you in the raw," and I am afraid the unexpected blow has elicited an editorial from you not exactly in accordance with your usual fair and logical power of argument.

The whole point in dispute, as I see it, is that the E.T.U. toed (for once) the E.F.E.A.'s line, and because the E.T.U. is "of doubtful repute" you turn on the E.P.E.A. and ask them why they allow it.

Ben Hur.

London, *October 10th*, 1920.

I thank you for your kind and flattering note to my letter of the 4th inst.; remarks of that nature ought not to pass without comment.

Presumably the note was meant more as an explanation of matters than an answer to my letter. It hardly convinces one as being a genuine expression of opinion, but rather a set of pickings such as one frequently finds a lawyer resorting to in defending a hopeless case—an attempt to confuse. Possibly it was intended to be so?

Perhaps I did not make it as clear as I might have done, that the E.T.U.'s adoption of a "settlement by agreement" policy was not necessarily permanent, but I think it was sufficiently clear to anyone who did not want to read it otherwise.

In any case it was not the E.P.E.A. that changed its policy; the employers who refused to try and settle by negotiation certainly made a serious mistake, and must not expect support from the E.F.E.A. under such circumstances, though there is no doubt that E.P.E.A. men as a body (as they have already shown) are fully aware of and anxious to execute their duties—public and other.

As regards the public, how much do they care whether E.P.E.A. men live or starve so long as their lights, their tramways, their conveniences of every kind continue? When the public show one tenth of the regard for E.P.E.A. men that the latter have already shown for the public, arguments on the basis of a man's "higher duties to the public" will begin to have weight.

Pollux.

October 10th, 1920.

[We refer to this matter in our leading columns.—Eds. Elec. Rev.]

External Wasting of Fuel Economiser Pipes.

In your contributor's interesting article under the above title the statement is made that the water is very much colder at the feed inlet end of the ordinary type of economiser than at the other end, and this is given as the reason why the pipes often show excessive wastage at that end. Now, this is not the case, since, in the first place, all the pipes work in parallel, and, therefore, all receive water at the same temperature; and, secondly, as I have already shown in your pages ("Some Sources of Error in Thermometry," December 29th, 1916), the lowest water temperatures in an economiser are found, not at the feed inlet end, but at the other end, in spite of the higher flue gas temperatures obtaining there. The reason why, in spite of this fact, the deposition of moisture and consequent corrosion take place at the feed inlet end is due as much to the low gas temperature at that end as to the low temperature of the water.

With regard to the warming of the inlet water, it should be remembered that the higher the inlet temperature is made the less efficient will the economiser be, and for this reason it is doubtful whether the system sometimes adopted, of using a small section of the economiser at the cold end as a preliminary heater by arranging it to work in series with the main economiser, is not more justifiable from an economical point of view than the use of the various contrivances for warming the inlet water described by your contributor.

I was somewhat surprised to find no mention of the "National" circulator as a means for increasing the temperature of the feed water. This apparatus is quite efficient for the purpose, it does not require the feed pumps to deal with warm water, it has no moving parts, and, once adjusted, it remains self regulating, as the amount of hot water by-passed by it is roughly proportional to the flow of water to the economiser.

It would be interesting to know how the steel tube economisers which appear to be coming into favour at the present time compare with the old cast-iron economisers as regards wastage.

S. B. Pausey.

Loughborough,
October 4th, 1920.

Domestic Supply Pressure and Wiring.

I have read with considerable interest the article and correspondence recently appearing in your columns on domestic supply pressure and wiring, and as a wireman would like to add my quota in favour of the "Looped Tube" system of wiring as possessing considerable advantages over any system of concealed wiring at present in use in this country:—

1. Lower installation cost.
2. All wires may be pushed or drawn in after plastering, &c., is finished.
3. A "live pair" can always be found at any light outlet and consequently additions can be carried out, or "trouble" located and removed with the minimum of expense.
4. There are no boxes of any description concealed under the floors, and no loose boards or pockets in floors are necessary.
5. Generally speaking, there will only be two wires in a tube.

The essential differences between the usual English method and the "Looped Tube" method as used in America for the last fifteen years to my knowledge are perhaps best shown in the diagram. It will be noticed that the latter system takes slightly more tube than the ordinary method, but against this must be set the saving in wire and fittings and the great saving in labour of wiring. A valuable "stunt" that is not

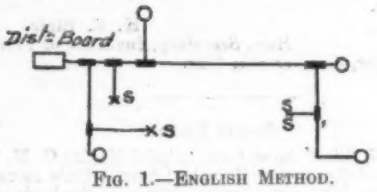

Fig. 1.—English Method.

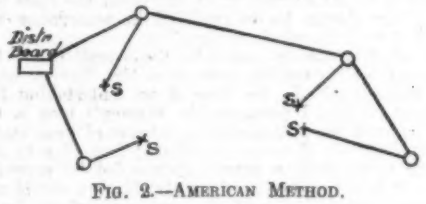

Fig. 2.—American Method.

Fig. 3.—Bonding Device.

generally used is to use the third plate of a three-plate ceiling rose as the looping-in point for the positive wire or switch feed. Where several tubes enter a ceiling point some simple bonding device is necessary if continuity is desired, and I would suggest strip copper ½ in. wide perforated every ½ in. with a 3/16-in. hole and fastened in the manner indicated in fig. 3.

The device makes a good contact at less cost than any bonding device I know of, and is adaptable to any size or number of tubes.

With couplings, where necessary, it is the only fitting required, no tees being used, and the tube being bent instead of using elbows.

The idea is fairly prevalent amongst wiremen and contractors that "close-joint" tube cannot be bent in a decent right angle. This is quite a mistake. With a block of hardwood bored accurately to the size of the tube and the edge of the hole gouged out in the arc of a circle, no difficulty will be found in bending ½ in. or ¾ in. tube in a right angle bend with a radius of about 3 in.

Where two such bends are encountered in a run, as from ceiling point to switch, or from one ceiling point to another, the wires push in quite freely, no "draw wire" or "fishing" being required; and wiring becomes very simple and quick. The wiring of one point takes only a few minutes. I do not claim for this system that it is suitable for old buildings, but for the large number of new houses at present being erected all over the country, in my opinion, it knocks all other systems including C.T.S. into a cocked hat.

Archibald J. Inch.

Berkhamsted.
October 11th, 1920.

Road Transport.

With reference to the letter of "Tractor" which appeared in a recent issue of your journal, in which the writer stated that, with the exception of Sir H. P. Maybury, he failed to find the names of any members of the Institute acquainted with modern road work, and, unless more attention is given to the science and art of road construction for present-day traffic, those who are responsible for providing transport and dealing with road traffic are likely to have some difficulty in the smooth running of the heavy and increasing motor traffic that roads will have to carry—the latter concludes with the comment "that it looks as if the Institute of Transport is putting the cart before the horse."

I solicit the hospitality of your columns to point out that, in addition to Sir Henry Maybury, Director-General of Roads, Ministry of Transport, Sir Maurice Fitzmaurice, C.M.G. (a former engineer of the L.C.C.), Mr. W. Willmott (until recently County Surveyor of Warwick), and Mr. A. Dryland, County Surveyor, Middlesex, who are members of the Council, the membership of the Institute includes the surveyors of the counties of Bedford, Durham, Gloucester, Isle of Ely, Kesteven, Leicester, Kent, Nottingham, Somerset, Stafford, East

Suffolk, West Suffolk, Worcester, and the East and West Ridings of Yorkshire.

In addition, many of the chief officers of the Roads Branch of the Ministry of Transport and numerous prominent Metropolitan and provincial municipal engineers are also associated with the Institute.

It would, therefore, appear that your correspondent must have indited his letter under a misapprehension, and that there is no cause for the belief that the important question of road construction in relation to transport will not receive the consideration it deserves by the Institute; on the contrary, an important paper dealing with this subject has already been read before the Institute by Sir Henry Maybury, and others are to follow.

H. S. Blair.
Hon. Secretary, Institute of Transport.

Westminster, *October 8th*, 1920.

Power Factor.

It would, I think, have been helpful if Mr. C. H. Harvey, in his letter of September 19th, had been a little more explicit with regard to his suggestion to charge on the basis of K.V.A.-hours, "the charge to be modified in accordance with the power factor of the whole system."

First, what is exactly meant by the overall power factor of the system, and secondly, how does Mr. Harvey propose to obtain this figure? In the case of an undertaking fed from one power station, I presume Mr. Harvey's idea is that the power factor of the power station at times of peak load should be taken, but this of course would vary from day to day. On the other hand, with a supply system fed by several power stations, it is not quite clear how Mr. Harvey would ascertain the overall power factor of the system; perhaps he will be good enough to explain.

The arguments deduced in my letter of September 14th with regard to the iniquity of charging on the basis of K.V.A.-hours are in no way affected, as Mr. Harvey supposes, by adjusting the K.V.A. charge to the overall power factor of the system. In taking 1d. per K.V.A.-hour I had in mind a charge of 1.25d. per unit at 80 per cent. power factor, *i.e.*, a charge per K.V.A.-hour of 80 per cent. of 1.25d.

If Mr. Harvey will look at the matter in this light, I think he will agree that what I have previously said is correct; but on the other hand, if he can produce facts and figures to show that this is not so, I am sure it would help the discussion.

E. W. Dorey.

Enfield, *October 12th*, 1920.

IMPORT TRADE OF CHINA.

The following table shows the value (and where possible the weight) of China's imports in 1919 of material of interest to the electrical and allied trades, indicating the principal countries of origin. The figures for 1918 are given in comparison, and notes of increases or decreases are added. The advance in Chinese purchases is striking, and it is noteworthy also that Great Britain is regaining its share rapidly. It is probable that the trade credited to Hong Kong was to a fair extent transacted with the United Kingdom.

The Chinese picul=133⅓ lb. average, and the Haikwan tael=5s. 3½d. in 1918 and 6s. 4d. in 1919.

Country whence imported		1918	1919	Inc. or dec.
Machine belting.—				
Total	taels	554,000	768,000	+ 214,000
Hong Kong ...	taels	48,000	58,000	+ 10,000
Great Britain ...	taels	224,000	296,000	+ 72,000
Japan	taels	168,000	230,000	+ 62,000
United States ...	taels	107,000	170,000	+ 63,000
Electrical materials and fittings.—				
Total	taels	4,308,000	5,170,000	+ 862,000
Hong Kong ...	taels	371,000	398,000	+ 27,000
Great Britain ...	taels	250,000	285,000	+ 35,000
Italy	taels	9,000	288,000	+ 279,000
Japan	taels	2,300,000	2,303,000	+ 3,000
Canada	taels	273,000	227,000	− 46,000
United States ...	taels	874,000	1,622,000	+ 748,000
Machine tools.—				
Total	taels	349,000	500,000	+ 151,000
Great Britain ...	taels	2,600	50,500	+ 47,900
Denmark ...	taels	—	21,000	+ 21,000
Japan	taels	199,000	222,000	+ 23,000
Canada	taels	2,000	28,000	+ 26,000
United States ...	taels	143,000	169,000	+ 26,000
Propelling machinery as boilers, turbines.—				
Total	taels	757,000	1,640,000	+ 883,000
Great Britain ...	taels	117,000	292,000	+ 175,000
Japan	taels	200,000	162,000	− 38,000
Canada	taels	67,000	108,000	+ 41,000
United States ...	taels	355,000	799,000	+ 444,000
Machinery, other, not textile, brewing, refining, &c.—				
Total	taels	5,019,000	8,417,000	+ 3,398,000
Hong Kong ...	taels	379,000	658,000	+ 279,000
Great Britain ...	taels	524,000	918,000	+ 394,000
Japan	taels	2,509,000	2,320,000	− 189,000
Canada	taels	326,000	740,000	+ 414,000
United States ...	taels	1,117,000	2,618,000	+ 1,501,000
Telegraph and telephone material.—				
Total	taels	501,000	940,000	+ 439,000
Hong Kong ...	taels	11,000	60,000	+ 49,000
Great Britain ...	taels	16,000	67,000	+ 51,000
Japan	taels	398,000	406,000	+ 108,000
Canada	taels	16,000	103,000	+ 87,000
United States ...	taels	55,000	151,000	+ 96,000
Aluminium, manufactured.—				
Total	piculs	240	1,760	+ 1,520
	taels	40,000	287,000	+ 240,000
Japan	piculs	180	1,590	+ 1,410
	taels	35,000	275,600	+ 240,600
United States ...	piculs	60	160	+ 100
	taels	5,000	10,000	+ 5,000
Brass and yellow metal; bars, sheets, wire, &c.—				
Total	piculs	19,000	27,000	+ 8,000
	taels	764,000	860,000	+ 96,000
Hong Kong ...	piculs	4,600	8,600	+ 4,000
	taels	191,000	247,000	+ 56,000
Great Britain ...	piculs	46	1,690	+ 1,644
	taels	3,000	56,000	+ 53,000
Japan	piculs	14,000	15,000	+ 1,000
	taels	534,000	468,000	− 66,000
Canada	piculs	30	1,330	+ 1,300
	taels	2,000	54,000	+ 52,000
United States ...	piculs	526	542	+ 16
	taels	33,000	32,000	− 1,000
Copper, bars, rods, sheets, plates, nails, and wire.—				
Total	piculs	11,000	40,000	+ 29,000
	taels	422,000	1,334,000	+ 912,000
Hong Kong ...	piculs	520	430	− 90
	taels	28,500	15,000	− 13,500
Great Britain ...	piculs	2	988	+ 986
	taels	80	23,000	+ 22,920
Japan	piculs	10,000	36,000	+ 26,000
	taels	378,100	1,209,000	+ 831,000
Canada	piculs	—	917	+ 917
	taels	—	29,000	+ 29,000
United States ...	piculs	195	1,460	+ 1,265
	taels	9,000	50,000	+ 41,000

THE LONDON MEDICAL EXHIBITION.

The tenth London Medical Exhibition, organised by the official managers of the exhibition of the seventeenth International Congress of Medicine, 1913, and the exhibition of the fifth Clinical Congress of Surgeons, London, 1914, was held at the Central Hall, Westminster, last week, and was well attended, considerable interest being shown in the various exhibits. These consisted of medicines, antiseptics, anæsthetics, tonic and patent foods, and other chemical products, together with surgical and dental appliances and instruments, artificial limbs, and last, but by no means least, electro-therapeutical apparatus and X-ray outfits. Many of the latter devices are well known, and need no elaborate description, but some types of apparatus that were on view are worthy of notice, and we hope to publish more about them at a later date.

The total number of exhibitors was about 90, of which some sixteen firms showed appliances of an electrical nature. Of these firms some half-dozen had on view X-ray outfits and accessories suitable for both medical and dental purposes, while about the same number of firms showed electrical devices of special interest to dentists.

In what follows we present a brief review of the exhibits of an electrical nature that were on view.

Messrs. Mayer & Phelps, amongst many other devices and instruments, exhibited an examination lamp fitted with a burner of the ¼-watt type, which gave a brilliant light, and an improved electroscope intended to be used for the direct examination of the larynx, œsophagus, and air passages.

Messrs. Allen & Hanburys, Ltd., in addition to other preparations, showed "Umbrose," or what is termed "shadow meal," being a specially prepared barium meal, and used for X-ray diagnosis. It is in the form of an impalpable powder and the barium sulphate is incorporated with the other ingredients in the process of manufacture, so that when administered a clear and regular shadow of good definition is produced. A useful feature is that the subject can easily prepare and administer the meal himself.

Messrs. Hawksley & Sons had on view a number of very interesting devices, which included various forms of De Zeng electric diagnostic instruments.

The Medical Supply Association, Ltd., exhibited a selec-

tion of its electromedical apparatus, such as has already received notice in our columns.

Mr. Leoline A. Edwards demonstrated the uses of his "Quidos" patents, several of which have been described in our "New Devices" columns at various times. They included an insulated oven, electrically or gas-heated, in which high or low temperatures can be maintained over long periods. The bed warmer is a neat and handy device which is heated by a low c.p. electric lamp, and which entails no fire risk whatever. It can be easily converted so as to form a study foot warmer, reading lamp, vaporiser, combined food warmer and night light, or it can be used as an "iron" for massaging by heat, by rolling the device over that part of the body to be treated.

The "Aurorascope" Co., Ltd., shows a very compact pocket outfit for the purpose of illuminated examination of the ear, mouth, throat, and teeth. By its use the vocal cords and drum of the ear can actually be seen in daylight, and it may also be used for the trans-illumination of the antrum and retinoscopy. The small electric lamp is supplied by a dry battery contained in the handle of the device.

Mr. W. H. Pettifor had on view a selection of electrical aids for the deaf, of various pitches and possessing different wave form characteristics. A test instrument is shown which enables a prescription to be written for an electric aid, to give the most suitable pitch, sound-wave form, and volume of sound for each individual case of deafness. These devices, in connection with which use is now being made of the "laryngophone," and another device which transmits sound through the bones of the head, are compact and efficient. Other exhibits included dry batteries, lighting and heating apparatus for medical use, and faradic and galvanic current apparatus.

Messrs. Ozonair, Ltd., exhibited various types of apparatus for the production of ozone for treatment as well as for disinfection purposes.

Messrs. Schall & Son showed Pantostat apparatus for converting the main supply current into a suitable form for cautery, light, galvanism, and faradism, and also for supplying power to drills, burrs, trephines, and massage apparatus. Headlights and other lamps, batteries, coils, and diathermy apparatus were also shown, together with a collection of X-ray apparatus and accessories.

Messrs. X-rays, Ltd., had on view a number of Coolidge and other X-ray tubes and accessories, in addition to a h.p. 10-k.v.a. transformer fitted with a rotary converter and rectifying disk in an oak cabinet for X-ray work.

The "Solus" Electrical Co. demonstrated a complete X-ray outfit including a gas-mercury-paraffin centrifugal interrupter, and intensifying and fluorescence screens.

Messrs. Kodak, Ltd., were concerned with the photographic side of radiography, and exhibited medical and dental film specimens, duplicated films, and accessories for developing, &c.

Messrs. Watson & Son (Electro-Medical), Ltd., in addition to medical coils and batteries for various purposes, showed portable X-ray equipment designed for private practitioners and dentists, in which there are no moving parts or mechanism requiring attention.

The S.S. White Co., of Great Britain, Ltd., exhibited various dental equipment, materials, and accessories, which included electrically-driven tooth grinding machines, &c.

Messrs. De Tray & Co., Ltd., had on view dental surgery equipment, sterilisers, and an X-ray outfit.

The Electro-Dental & Medical Co. showed electrical apparatus for the dental and medical professions, including switchboards, mouth lamps, sterilisers, compressors, radiators, and electrically-heated appliances, such as jugs, kettles, &c.

BUSINESS NOTES.

Bankruptcy Proceedings. — Arthur Kershaw, of Thornhill Lees, and Charles Herbert Wood, of Batley, trading together as electrical engineers, at Bradford Road, Batley.—At Dewsbury Bankruptcy Court, on October 7th, the public examination of these debtors took place. Both debtors are aged 22, and began business since demobilisation from the Army. Their deficiency was £1,656. They attributed failure to fluctuation in market prices, to workmen's wages, shortness of capital, law costs, and heavy initial business expenses. They admitted that they had not made a profit at any time since the commencement. The examination was closed.

Company Liquidations.—W. A. & H. J. Jacobs, Ltd., Leonard Street, Finsbury, London, E.C., electrical engineers, &c.—The creditors interested herein were called together on October 4th, at the Chartered Institute of Secretaries, London Wall, E.C. The shareholders had previously passed the usual resolution in favour of voluntary liquidation, and had appointed Mr. R. G. Sidford of 20, John Street, Adelphi, W.C., to act as liquidator. Mr. Sidford stated that the company had issued debentures to the extent of £2,000, while a claim had also been received from the Inland Revenue authorities for £17,302 in connection with Excess Profits Duty. He was, however, of the opinion that the claim would be allowed after proper representation had been made. The amount due to the unsecured trade creditors was in the neighbourhood of £16,000. With reference to the assets the liquidator stated that, speaking from memory, the plant and machinery was valued at more than £10,000, while there was a very good stock. The liquidator could not give any idea as to what the cost price of the stock was. The company did very well up to the end of December, 1918, but the trading and profit and loss account for the year ended December, 1919, showed a loss of several thousands of pounds, and it was believed that a further loss had been made during the current year. The peace programme of the company was the manufacture of bells on the mass production principle, and they appeared to have budgeted for at least 20,000 bells per week. Some time ago land was taken at Hendon, and a factory built at a cost of about £20,000. Owing to lack of capital it was decided to sell the factory, when it was completed, and no less than £32,000 was obtained for it. In answer to questions, it was stated that the debentures for £2,000 were only issued on July 24th of the present year. The position was discussed at some length, and eventually a resolution was unanimously passed in favour of an application being made to the Court for the appointment of Mr. C. Sunderland, of 15, Eastcheap, London, E.C., as liquidator of the company in the place of the liquidator appointed by the shareholders. Messrs. John Lysaght, Ltd., were nominated to make the necessary application to the Court, and a Committee of Inspection was also appointed, consisting of the following:—Messrs. John Lysaght, Ltd., Johns, Sons & Watts, Ltd., T. Bolton & Sons, Ltd., the Osmond Engineering Co., Ltd., and H. Wright & Co.

Harding Bros. (Engineers, Westminster), Ltd., 17, Victoria Street, Westminster, S.W.—First meeting, creditors and contributories, October 18th, at Carey Street, W.C.

Dissolutions of Partnership.—Jenner, Chetham and Co., electrical engineers, 11, Red Lion Square, W.C.—Messrs. R. M. Chetham and M. H. Jenner have dissolved partnership. Mr. Jenner will attend to debts and continue the business.

Electrical Maintenance Co., electrical engineers and kinematograph suppliers, 140, Wardour Street, W.—Mr. J. H. Hopkins and Mr. A. Hale have dissolved partnership. Debts will be attended to by Mr. J. H. Hopkins, who will continue the business.

Shefford & Thomas, electrical engineers and contractors, Salisbury Chambers, Wind Street, Swansea.—Mr. F. P. Shefford and Mr. W. J. Thomas have dissolved partnership. Mr. F. P. Shefford will attend to debts and continue the business.

Wood & Roberts, electrical engineers, 7, Salem Street, Oldham.—Messrs. H. R. Wood and D. A. Roberts have dissolved partnership. Mr. D. A. Roberts will attend to debts and continue the business.

Trade Announcements. — The Premier Armature Repair Co., electrical engineers, of St. Helens (Lancs.), have removed to 74A, Bridge Street.

Messrs. Robinson, Fraser & Co., electrical and mechanical engineers, of Galashiels, have removed from Channel Street, to larger premises in Galapark Road.

The address of the Latvian Consulate has been changed to 329, High Holborn, W.C. 1.

The Enterprise Manufacturing Co., Ltd., of Gun Street Electrical Works, Bishopsgate, have been appointed London agents for Messrs. Lowke & Sons, of Northampton, for switchboards of from ½ to 10 kw.

Messrs. Siemens Bros. & Co., Ltd., and Messrs. Siemens Bros. Dynamo Works, Ltd., announce that they are removing from their present offices at Palace Place Mansions, Kensington Court, W. 8, to Caxton House, Westminster, S.W. 1.

Catalogues and Lists.—Messrs. Hick, Hargreaves and Co., Soho Ironworks, Bolton.—A well-illustrated descriptive list of Diesel oil engines ranging from 50 to 1,020 b.h.p., giving details of construction and operation and photographs of actual installations.

Messrs. Isaacson & Brown, Ltd., 39, Furnival Street, E.C. 4.—Leaflet illustrating three types of copper earthing clips, and giving net trade prices.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C. 2.—Bulletin 30 S (16 pp.).—An illustrated catalogue of medical batteries, including galvanic and faradic batteries, induction coils and cells. Fully priced.

The Cambridge and Paul Instrument Co., Ltd., 45, Grosvenor Place, S.W. 1.—A postcard illustrating and describing the "Cambridge" a.m. galvanometer. Priced.

Igranic Electric Co, Ltd., 147, Queen Victoria Street, E.C. 4.—A postcard dealing with the advantages to be derived from the employment of the "Dean" patent motor-operated valve control.

Engineering and Lighting Equipment Co., Ltd., Sphere Works, St. Albans.—Leaflet illustrating new pendant gallery fittings, with "Anti-break" anti-vibration disks. Priced.

Messrs. Sands, Hunter & Co., Ltd., 37, Bedford Street, Strand, W.C. 2.—"Camera Bargains" (111 pp.), a comprehensive illustrated and priced list of cameras and accessories.

The Sun Electrical Co., Ltd., 118 and 120, Charing Cross Road, W.C. 2.—Publicity matter dealing with "Sunco" fires, consisting of a showcard (15 in. × 18 in.) in colours, showing a child seated before an electric fire; two illustrated and priced folders, and a priced booklet depicting a number of different types of "Sunco" fires."

Automatic and Electric Furnaces, Ltd., 281-283, Gray's Inn Road, W.C. 1.—An illustrated leaflet (4 pp.) illustrating and describing "Wild-Barfield" "Flat" electric furnaces which embody all the Wild-Barfield principles, including an excess temperature cut-out.

Messrs. Falk, Stadelmann & Co., Ltd., Efesca Electrical Works, 83-87, Farringdon Road, E.C. 1.—Catalogue No. 456 (24 pp). A very comprehensive list of "Efesca" lanterns for gasfilled and vacuum tungsten lamps, for street and outdoor lighting, shop lighting, industrial lighting, &c. Fully illustrated and priced. A copy will be sent to any reader on application.

Book Notices.—"Patents for Inventions, and Information respecting Trade Marks and Designs" (16 pp.). London: King's Patent Agency, Ltd.—This booklet is divided into nine sections, dealing respectively with:—British patents, procedure in patenting, foreign and colonial patents, sale of patents, trade marks, designs, copyright, and two sections dealing with the work of the publishing firm, with testimonials.

No. 1—1920.—"Lists of British Standard Rolled Steel Sections for Structural Purposes (Revised July, 1920)" (19 pp.). London: Crosby Lockwood & Son (for the B.E.S.A.). Price 1s. net.—Publication has been delayed pending the decision of the American Engineering Standards Committee regarding the applicability of the revised British standards to American practice, but owing to the American authorities requiring a longer period for their deliberations, the Association has decided to publish the report.

"Electric Switch and Controlling Gear." By C. C. Garrard. Pp. xxii + 654, figs. 529. Price 25s. net. "Electric Welding." By H. S. Marquand. Pp. 204, figs. 90. Price 12s. 6d. net. "Electrical Handling of Materials." Vol. I.: "Electrical Equipment." Pp. xv + 200, figs. 231. Price 25s. net. London: Benn Bros., Ltd.

Technologic Paper No. 171 of the U.S. Bureau of Standards. "Automatic Apparatus for Intermittent Testing" (7 pp.) Washington: Government Printing Office: Price 5 cents.—A description of apparatus primarily intended for testing dry cells and storage batteries, but applicable to other forms of intermittent testing.

"The M. & C. Apprentices' Magazine." Vol. IV. No. 15. 56 pp.—The autumn number of this house magazine contains many interesting articles and notes. A description of the Dalmarnock power station is given, as well as a continuation of the "Reminiscences of a Pioneer," by Mr. Henry Edmunds.

South African Engineers' Electrical and Allied Trades Directory. 1920. Compiled and published by the *South African Mining and Engineering Journal*, Johannesburg. (Sole agent in London, L. Hewson, 56, Ludgate Hill, E.C. 4.) 30s. net.—This directory will be found of service to all firms in the United Kingdom having, or desiring to have, electrical and engineering trade connections with South Africa. It is divided by means of sectional cards into the following parts:—Alphabetical list of firms in South Africa, Rhodesia, Mozambique, &c.; geographical section classifying firms under their towns; overseas manufacturers represented in South Africa; buyers' guide showing suppliers of engineering specialities; list of the principal factories in South Africa and Rhodesia; section relating to mining and industrial companies.

Scientific Paper No. 389 of the U.S. Bureau of Standards, "Relative Spectral Transmission of the Atmosphere" (33 pp.), dealing with the transmission of light under various weather conditions, with curves showing results. Illustrated.

Twelfth Annual Report of the Hydro-Electric Power Commission of the Province of Ontario for the year ended October 31st, 1919 Vol. III (166 pp.). Toronto: A. T. Wilgress.—The third volume of this report deals with hydraulic investigations, and an enormous amount of statistics has been collected and tabulated.

The *Bulletin* of the Hydro-Electric Power Commission of Ontario, Vol. VII, No. 6 (36 pp.).—The August, 1920, number of this publication deals principally with the provision and application of power in rural districts. It also contains an illustrated article upon "The Diffusion Characteristics of Translucent Lamp Bulbs," which gives the results of tests carried out in the Commission's laboratories.

"Advertising the Technical Product." By Sloan & Mooney. Pp. x + 365. London: McGraw-Hill Publishing Co., Ltd. Price 30s. net.

"Science Abstracts" (A and B). Vol. XXIII. No. 272. Part 8. August 31st, 1920. London: E. & F. N. Spon, Ltd. Price 2s. 6d. each.

"*Journal* of the Institution of Electrical Engineers." Supplement to Vol. LVII. Part II. Published October, 1920; also Index to Supplement to Vol. LVII. London: E. & F. N. Spon, Ltd. Price 31s. 6d.

Foreign Trade.—September Figures.—The following are the values of imports and exports of electrical goods and machinery in September:—

	September, 1920.	*Inc. or dec.*	*9 months*, 1920 *Inc. or dec.*
Imports.	£	£	£
Electrical goods, &c. ...	180,780	+ 87,659	+ 133,383
Machinery	1,675,794	+ 432,631	+ 3,425,464
Exports.			
Electrical goods, &c. ...	888,237	+ 427,653	+ 4,185,195
Machinery	5,547,702	+2,644,582	+21,658,508
Re-exports.			
Electrical goods, &c. ...	16,688	+ 12,934	+ 26,864
Machinery	156,981	− 11,309	+ 574,335

The French Jeumont Works.—It is stated that the production of large cables has now been resumed at the Jeumont cable factory, belonging to the Ateliers de Constructions Electriques du Nord et de l'Est, as a result of the starting of the copper rolling mill.

Private Meeting.—Marryatt & McNaught, Ltd., electrical engineers, Askew Engineering Works, Askew Crescent, Shepherd's Bush, London.—A meeting of the creditors interested herein was held on October 8th, at the offices of Messrs. Turner and Co., solicitors, 89, Chancery Lane, W.C. It was stated that the meeting had been called as a Receiver had been appointed on behalf of the debenture-holder in the company. The Receiver said that he was appointed on September 16th last, and when he subsequently visited the works he found that a week's wages were due, and there was only a nominal balance at the bank. In order to get money in promptly, he offered a discount to the book debtors of 5 per cent., and some debts were collected. The wages were now being paid regularly. On his appointment he found that an execution had been levied, and a sale was advertised, but the Sheriff withdrew. The liabilities to trade creditors amounted to £1,157, while Mr. C. T. McNaught appeared as a cash creditor in the books for £1,303. For present purposes Mr. McNaught had been included as a creditor for £400, making total liabilities of £1,557. At break-up prices the assets were estimated to realise £1,737, from which had to be deducted £160 for preferred claims, and £1,300 due on debentures. The net assets were therefore reduced to £277, or a deficiency as regarded the unsecured creditors of £1,330. The estate showed about 2s. 11d. in the £ for the creditors. The book values of the assets totalled £2,050, and if those figures were taken as correct, the estate would show about 6s. 11d. for the unsecured creditors.

Mr. E. H. Hawkins (Messrs. Poppleton & Appleby) said he understood that the debentures were issued last January, and the present holder was the widow of the late Mr. W. McNaught.

The Receiver said that was the case. When the debenture was issued, a sum of £900 had already been advanced to the company, and a further £400 was then paid in cash.

Mr. P. Houstoun said that the file of the company at Somerset House showed that there were only two shareholders in the concern. Each of those shareholders held 500 ordinary shares, and a similar number of preference shares. When the company was formed, shares of the face value of £1,000 were issued to the vendors as the consideration for the assets they transferred, while £1,000 was subscribed in cash.

In answer to a question, the Receiver said the last balance-sheet of the company was prepared at March 30th last, and it showed in the profit and loss account a debit balance of £2,383. It was not true to say that the company had always traded at a loss.

Mr. Hawkins said that the execution creditors felt they had been badly treated. They were allowed to put the Sheriff in, and it was not till further expense had been incurred by arrangements being made for a sale that the Receiver was appointed.

After a short discussion, the creditors unanimously passed a resolution requesting the directors of the company immediately to put the concern into voluntary liquidation, with Mr. W. Osborne, of Messrs. Corfield & Cripwell, accountants, Balfour House, Finsbury Pavement, E.C., as liquidator.

"Exide" Battery Service.—Following the reduction of the list prices of "Exide" starting and lighting batteries, the Chloride Electrical Storage Co., Ltd., is now able to offer users the further advantage of a first-class battery service. It has already appointed a large number of important firms all over the country to establish "Exide" battery service stations in their various towns, and many of these are in operation, whilst others will shortly be in a position to undertake the work. The service system will ensure that an "Exide" battery user need never have his car out of commission through battery trouble, as he will have in his vicinity an "Exide" service station where he can obtain advice and assistance whenever necessary from an expert trained in the company's works. His cells can be kept in good condition, tested from time to time, have distilled water added, and in cases where it may be necessary to remove the battery from the car for repairs or recharging, a rental battery suited to his car will be at his disposal for a small sum, while his own set is receiving attention. In addition, all motorists will be able to obtain from stock at their nearest service station a new ready-charged battery suitable for their cars, at any time, without having to experience the delay on rail and heavy carriage charges usually involved when batteries have to be sent from a distance.

British Magnetos on Aeroplanes.—As a result of the various tests at the Air Ministry's competitions held at Martlesham Heath, the awards of the judges in the large and small aeroplane classes have just been made; four out of the five prizes awarded were won by aeroplanes whose engines were fitted with B.T.H. magnetos. Aeroplanes whose engines were fitted with B.T.H. magnetos also won the first and second prizes at the 1919 and 1920 Aerial Derby at Hendon.

Cable Drums.—The following circular was issued by the Cable Makers' Association, dated October 1st:—"The cost of cable drums being now three or four times what it was before the war, has necessitated reconsideration of the arrangements which have been in force in the past as to supply and loan of drums for the delivery of cables. From October 1st, 1920, onwards, members of the Cable Makers' Association will proceed as follows:—

"The prices quoted for cables will include the loan of a drum or drums with lagging where necessary for a period of three months, the purchaser accepting responsibility for their return, carriage paid, to the maker's works, and for any loss or damage sustained by them in respect of these drums.

"After the expiration of three months, rental will be charged in accordance with a schedule which will also give the prices at which the drums may be purchased subject to the deduction of any rental already paid for them.'

New French Electrical Companies.—There has been formed at Paris (48, Boulevard Haussmann), the Société Nantaise Electro-Chimique et Metallurgique, for the working of known and unknown processes of treating metallic residues, alloys, and ores, and the recovery of tin from waste. The capital is 7,500,000 fr.

At Conflans-sur-Lanterne (Haute Saône) has been established the Société Electrique La Lanterne, for the production, purchase and sale, for all uses, of electricity. Capital, 1,750,000 fr.

Office Commercial des Fabricants Spécialistes de l'Industrie Electrique is the style of a company embodied at Lyons (32, Rue de Marseille). Capital, 100,000 fr.

The Société d'Electricité du Haut-Vivarais is the title of a company established at Annonay (Place de Alsace-Lorraine), Ardèche, whose objects are the generation, use, transport, distribution and sale of electric current, and the purchase, construction, and working of hydraulic and other stations. The capital is 500,000 fr.

Under the style of Porcelaine de la Haute-Viénne has been constructed at Paris (11, Rue du Regard), a company for the carrying on of all operations appertaining to the manufacture of articles in porcelain, faience, ebonite, and like substances. The capital is 500,000 fr.

The Home Secretary and Herr Rathenau.—We do not understand the solicitude of the London correspondent of the *Manchester Guardian* on behalf of Herr Walter Rathenau, of the Allgemeine Elektricitäts Gesellschaft. If the Home Secretary refused permission for him to visit England for three days to attend an international economic conference, we may be pretty certain that he had a good reason for so doing. Electrical readers, at any rate, will remember his war-time thoughts and designs; his regrets that the war was begun a year too soon; and his desires that next time the same mistake should be avoided. We have no room here in the electrical industry for any German who can callously contemplate a next time.

Catalogues for Mombasa.—The Mombasa Electric Light and Power Co., Ltd., was deluged with catalogues in response to its notice in the Electrical Review of July 23rd. It desires to thank manufacturers, and to ask them to keep the supply up-to-date.

Electrical Exhibition at Greenock.—With commendable enterprise, the Greenock Corporation is holding an electrical exhibition at the Town Hall. Opened on October 12th, the exhibition is to continue until the 19th. The main exhibits are lighting, heating, and cooking apparatus, and electrical labour-saving devices for the home or office. During the exhibition, "lecturettes" are being given by electrical experts. Other attractions include a daylight kinema show, wireless telegraph demonstrations, and a "Creed Stentorphone," a loud-talking machine. Teas are being served, and an orchestra is in attendance. Mr. Whysall, the borough electrical engineer, has secured the services of Mr. Cedric F. White as organizer.

Concert.—A smoking concert was held on October 4th at the "Borough Arms," Walsall, by the male employés of the Walsall Electrical Co., Ltd., between 50 and 60 being present. The proceedings were opened by a speech from the chairman, Mr. V. Delebecque. The next concert is arranged for December 6th, when the employés will be pleased to see their friends in the electrical profession present.

Imports into Finland.—The following particulars of certain import licences granted between January 1st and August 1st, which have been received in the Department of Overseas Trade from the Finnish Consul-General in London, will give some indication regarding the goods most in demand in Finland at the present time:—

	Value in Millions of Finnish Marks.	
	Licences applied for.	Licences granted.
Rubber and manufactures thereof	63·1	40·2
Iron and steel manufactures	302·7	243·8
Other metals and manufactures thereof	55·5	47·7
Incandescent lamps	26·7	6·6
Machinery, electrical, dairy, and agricultural motors, &c.	302·7	222·9

Correction.—In the advertisement of Messrs. Guy Chantrill & Co., appearing on Sup. p. 20 of our advertisements last week, by a printer's omission it was stated that the National Industri A.S. were makers of any size of transformer up to 500 K.V.A. The figure should have been *5,000*. We regret the error.

National Joint Board of Employers and Members of Staff, Electricity Supply Industry, No. 6 (West of England) Area.—The first meeting of the No. 6 Area District Joint Board was held on Monday last, at the Labour Exchange, Bristol. The chair was taken by Mr. H. Faraday Proctor, at the request of both the employers and the staff members. The Constitution of the District Joint Boards, as printed and circulated by the National Joint Board, was discussed and approved, and the following officers were appointed for the ensuing year:—

Chairman.—Alderman A. A. Sennington (Bristol Electrical Committee).

Vice-Chairman.—Mr. A. J. Ostler (E.P.E.A.).

Treasurer.—Mr. F. J. Elliott (E.P.E.A.).

Joint Hon. Secretaries.—Mr. R. Glass, Employers' side; Mr. J. Elliott Staff Members' side.

British Trade-Mark Applications.—Appended is a summary of the recent applications for British trade-marks in respect of goods associated with the electrical trades and industries:—

Klik. No. 404,019. Class 16. Electrical insulators, switch bases, lamp shades, &c. No. 404,020. Class 18. Electric bell systems, and electric fire alarm apparatus.—B.E. Co. (London and Birmingham), Ltd., Hendon House, 57, Upper Thames Street, London, E.C. May 11th, 1920.

Hermastic. No. 404,477. Class 50. Electrical insulating materials. Wailes Dove Bitumastic, Ltd., 5, St. Nicholas Buildings, Newcastle-on-Tyne. May 25th, 1920.

Apex (lettering combined with design). No. 395,364. Class 6. Electric vacuum cleaners.—Apex Electric Manufacturing Co., 1,111, Power Avenue, Cleveland, O., U.S.A. August 19th, 1919.

Multasbest. No. 404,057. Class 8. Electric cables.—Ward and Goldstone, Ltd., Sampson Works, Salford, Manchester. May 12th, 1920.

Callender Cable (lettering combined with design). No. 405,402. Class 8. Paper-insulated electric cables.—Callender's Cable and Construction Co., Ltd., Hamilton House, Victoria Embankment, London, E.C. June 22nd, 1920.

Giant. No. 403,464. Class 13. Conduit fittings.—March and Newey, 217, Holliday Street, Birmingham. April 24th, 1920.

Quasi-Arc. No. 403,794. Class 13. Electrode holders, electric switches, &c.—The Quasi-Arc Co., Ltd., 3, Laurence Pountney Hill, Cannon Street, London, E.C. May 5th, 1920.

Norus. No. 404,241. Class 13. Electric bells, No. 404,242. Class 18. Electric bells and alarm systems for use in buildings.—Messrs. Veron, Tschumi & Co., St. Imier, Switzerland. May 18th, 1920.

B.E.V. (lettering combined with design). No. 403,800. Class 6. Machinery of all kinds. No. 403,801. Class 8. Electric switchboards, accumulators, batteries, cables, and other electrical accessories. No. 403,802. Class 13. Electric contacts and terminals, fusible cut-outs, ignition plugs, &c.—British Electric Vehicles, Ltd., 1, Queen Victoria Street, London, E.C. May 5th, 1920.

The Latvian Market.—The following are among the more important lines of goods required by Latvia:—New cast-iron, iron, steel, white metals, copper, and other metals and castings made thereof; various materials required by the Ministry of Communication; working machinery and tools; wood and metal-working machinery; machinery and spare parts for textile industry and others; power machinery, steam boilers and components; driving belts.

Electricity Supply Rifle League.—The following are the results of the September matches:—City Co., 566, Hackney, 516; Metropolitan Co., 535, Hackney, 540; Hackney, 546, St. James's, 522; City Co., 556, Central, 545. The Metropolitan team now heads the League with 18 points; Shoreditch and the City Co. are next with 14 points each.

Social Events.—Members of the bowling section of Blackpool Electricity and Tramways Institute took supper together on October 7th. Mr. C. Furness, tramway general manager, presided.

Glasgow Corporation Electricity Department's Golf Club has just concluded a splendid season, and is looking forward to the social season, which opens on October 28th with the annual dance.

Spain.—A new concern, the Societá Eléctrica de Orense, has been constituted at Bilbao with a capital of 1,500,000 pesetas, for the purpose of producing, distributing and selling electric power.—*Reuter's Trade Service* (Madrid).

LIGHTING AND POWER NOTES.

Accrington.—Progress of Extensions.—Alderman Higham reported to the Electricity Committee that the extensions at the electricity works were progressing satisfactorily. The turbo-generator would be on test the first week in December. The boilers were in course of erection, so that they might be giving power early in the new year. The ban on overtime was having a detrimental effect upon the works, and they were trying to arrange some way out of the difficulty. If it continued during the winter, it would be impossible for them to get through without some interruption in their supply.

Barrow-in-Furness.—Proposed New Station.—The General Purposes Committee of the Town Council, having under consideration the question of the proposed new power station, has instructed the Electricity Committee to endeavour to obtain a three months' option on the Vulcan Works site, and to ask the Electricity Commissioners for their proposals in connection with Barrow.

Birkenhead.—Electricity District—Objection.—The Town Council has objected to the inclusion of the town in the Mersey and West Lancashire Electricity District area, and has requested the Commissioners to grant an extension of time to March 31st to enable a scheme to be prepared and submitted.

Blackburn.—Loan.—The Town Council has decided to borrow £50,000 for the laying of electricity mains.

The Electricity Commissioners have informed the Town Council that they have decided to postpone the construction of a main transmission line between Blackburn and Preston until the submission of a scheme for the reorganisation of the supply of electricity in the Mid-Lancashire District.

Bradford.—New Generator.—It is hoped that the new turbo-generator which has been installed at the Valley Road works of the Bradford electricity department, and which has been in course of erection for some months past, will be put into service on October 23rd. The generator, which is of 10,000-kw. capacity, will practically double the present output of the station.

Canterbury.—Bulk Supply.—The Town Council has informed the Faversham Town Council that it will be unable to supply electricity in bulk until the new generating plant is completed next summer.

Cardiff.—Extensions.—At a meeting of the Electricity Committee, Councillor J. Taylor, who presided, remarked that the proposed extension of the Corporation electricity supply to the docks and parts of the city not yet covered would cost about £100,000. The work has been held up by delay in delivery of the necessary cables.—*South Wales Daily News.*

Chelmsford.—Price Inquiry.—A petition from 308 consumers against the proposed increase in the price of electricity having been sent in, the Ministry of Transport has decided to hold a local inquiry into the matter.

Continental.—Germany.—Owing to a strike of boiler-house employés at the Moabit power station, a great part of Western Berlin was in darkness on October 5th, and the whole of the tramway services were suspended. The strikers returned to work on October 7th, their demand for a six-hour working day having been agreed to by their employers.

Owing to a strike of municipal workers, Leipzig is without electricity, gas and water supplies.

France.—Owing to an improvement in the coal situation, arrangements have been made to augment the present street lighting considerably. About 1,500 electric lamps are to be installed in some of the main thoroughfares.

Belgium.—According to the report of the Compagnie Electrique Anversoise, of Antwerp, the output of the company's plant increased from 5,849,894 kw.-hours in 1918-19 to 12,130,509 kw.-hours in 1919-20, a total which very closely approaches the pre-war output. Owing, however, to the high cost of coal, higher wages, &c., the financial results are not very favourable, as it was found impossible to increase the charges for supply over the pre-war rates. The negotiations with the municipal authorities of Antwerp with reference to increased charges have, however, now been successfully arranged, a scheme whereby a basis rate is fixed, and which can be raised or lowered in accordance with the varying general expenses and the price of coal, having been agreed upon. The company's concession has also been extended for a further period of five years—that is, until the end of 1932. During the course of the present year the plant at two of the transformer stations is to be increased in order to meet the ever-increasing demand.

Russia.—Referring to conditions at present prevailing in Moscow, the daily Press states that "the only chimneys that are smoking" are those of the electricity generating stations; electric light is used in such institutions as prisons, Government offices, &c., but no energy is available for consumption in private houses. A moderate tramway service is maintained until 8 o'clock at night.

Darlington.—Loan Sanctioned.—The Electricity Commissioners have sanctioned the borrowing of £8,200 for the purchase of a boiler for the electricity works.

Dartford.—House Lighting. — The Urban District Council has applied for a loan of £1,337 for mains and distributors for supplying electricity to the Council houses.

Derby.—Year's Working.—It is reported that the gross profit on the electricity undertaking for the year ended March 31st last was £47,239. The net balance after payment of capital charges was £7,663, and it is recommended that £5,000 be allocated to the relief of rates.

Dewsbury.—Loan.—The Town Council is applying for sanction to a loan of £2,372 for laying cables to a local chemical works. The estimated revenue from this source is £800 per annum.

Doncaster.—House Lighting.—The Electricity Committee has adopted a report of the engineer, and estimate of cost, of extension of mains to supply the Corporation houses on the Carr House estate. It was decided to apply for power to borrow £10,493 for the provision of high-tension mains, a transformer sub-station, and the laying of distribution mains and services.

Dublin.—Street Lighting.—The Lighting Committee has declined to comply with a request that the streets should be lighted at the expiry of the "curfew" period, *i.e.*, at 3 a.m., owing to the expense involved.

The Rathmines Council has decided not to extinguish the street electric lamps until 3 a.m.

Electricians' Strike.—Dublin electricians who went on strike to enforce a demand for an increase in their weekly allowance from 21s. to 28s. per week while at work in provincial centres, have accepted an offer of 27s., and work has been resumed.

Egypt.—Cairo Strike.—A strike of the employés at the gas and electricity works on October 5th plunged the whole of Cairo into darkness.

Liverpool.—Loan.—The City Council has agreed to the recommendation of the Tramway and Electric Lighting Committee to apply for sanction to borrow £115,000 for the purchase of additional generating plant for the Lister Drive electric power station.

Manchester.—Bulk Supply.—The Finance Committee, which at first was unable to agree to the proposals regarding the supply of electricity to the Lancashire Electric Power Co., has now reconsidered the position, and has presented a report concurring with the suggestions made by the Electricity Commissioners. The *Financial News* states that the circumstances of the present application are peculiar in so far that the proposal is to supply in bulk to a company working for profit, therefore the basis on which the Electricity Committee makes its recommendations is a profit-earning one, and, according to its report, whatever the capital expenditure may be, the Corporation should receive a return of approximately 3 per cent. on the outlay after providing interest and sinking fund and all outgoings. The capital expenditure involved in the scheme is estimated at approximately £700,000, and the Electricity Committee recommends the Council to make an application to borrow this amount.

The Finance Committee has given considerable attention to the principle involved in the above proposal, especially in view of the heavy capital commitments and loan requirements of the Corporation, and since its previous report, which was withdrawn, further facts have been placed before it by the chairman of the Electricity Committee and the chief engineer and manager, including the following important points:—

1. The expenditure will be for machinery.
2. The expenditure will be spread over about three or four years.
3. The first payments will not fall due for at least a year.
4. The expenditure may be looked upon as expenditure in anticipation of Manchester's own requirements.
5. Manchester will be keeping its place as the chief authority in the Government's scheme for South-East Lancashire.

Merton.—Proposed Extensions.—The Urban District Council is to ask the Electricity Commissioners to sanction the installation of a 3,000-kw. turbo-alternator at an estimated cost of about £50,000.

Nelson.—New Generating Station.—It is stated that the cost of the erection of a new station at Preston would be £1,000,000. It would mean an expenditure of £50 per kw.; the existing station cost £17. The cost of laying a cable from Blackburn to Preston would be a penny per unit, and this without any machinery. Nelson, in company with other boroughs, is objecting to this, and an inquiry is to be held before the end of the present month.

North Wales.—Water Power.—At a recent conference of representatives of electricity supply authorities of North Wales, the following resolution was passed for submission to the undertakings concerned before being forwarded to the Electricity Commissioners:—"That this Conference of various undertakers in the three counties of Carnarvon, Anglesey, and Merioneth, whilst approving of the area defined by the Electricity Commissioners for North Wales, as most conducive to the efficiency and economy of the supply of electricity and to convenience of administration, considers that the three counties named have the first claim on the natural water-power resources existent therein, and for this reason that any scheme to be approved by the Electricity Commissioners should provide for a delegation of the powers of the Joint Electricity Authority to a committee representative of the local authorities and undertakers in the three counties."

Portsmouth.—Extensions.—The Town Council has adopted the Electricity Committee's proposal for the installation of a 4,000-kw. turbo-alternator at the Gunwharf Road works.

Queenborough. — Electricity Supply. — Sheerness Electric Power Co. having applied for power to increase its charges, the Town Council has decided to protest, and to consider the question of providing a municipal supply.

Rochdale.—Bulk Supply.—The Manchester Corporation's refusal to provide capital for additional plant at the Barton power station of the Lancashire Electric Power Co., caused the latter to withdraw its offer to supply additional energy in bulk, to the extent of 10,000 kw., to the Rochdale Corporation. It is anticipated that the Manchester Corporation having now decided to provide the necessary capital, the company will be prepared to renew its proposal, and thus assist the Corporation in its difficulty of meeting the demands of prospective customers.

Salford.—Loan.—The Town Council has been recommended to apply for sanction to borrow £95,886 for electricity, tramway, and other extensions.

Stone.—Protest.—The Water and Lighting Committee of the Urban District Council has had under consideration the question of the Stone Gas Co.'s repeated applications to the Board of Trade for extensions of the time in which to complete the compulsory works in connection with the supply of electricity, mentioned in the Stone Gas and Electricity Act, and has decided to object to any further extension beyond a period of three months from the date of the expiration of the present period.

South Africa.—Cape Town.—The Town Council has agreed to supply the suburban railway stations from Mowbray to Kenilworth inclusive from the municipal mains at 4d. per unit. This will obviate the necessity of the railway department transmitting energy from its own sub-station at Cape Town.

The Town Council has accepted the tender of Messrs. J. Carrick and Sons, Ltd., of Edinburgh, for a 50-ton overhead crane for the Dock Road power station. The price is £5,720 f.o.b. delivery ten months.

Aliwal North, (Cape Province).—A serious accident recently occurred at the local power station. A gang of natives was working in the turbine well, replacing a spider, when a shaft slipped, causing the death of two natives and injuring others. A white man and two natives were taken to hospital.

Oudtshoorn, (Cape Province).—The following orders have recently been placed for the partial reconstruction of the power station:—British General Electric Co., Ltd., a 900-ampere-hour battery; Messrs. J. W. Sealer & Franks, a Bruce Peebles 55-H.P. booster plant; Messrs. Hubert Davies & Co., Ltd., a complete steam plant, consisting of a B. & W. boiler fitted with superheater; Browett, Lindley-E.C.C. 150-KW. set arranged for static balancing, feed-water heater, feed pumps, &c. Specifications were drawn up by the municipal electrical engineer, Mr. R. D. Coulthard, A.M.I.E.E.

Swansea.—Strike Averted.—A deputation of representatives of employés at the electricity works was received by the Electricity Committee on October 2nd. The men's grievance was that the 6s. increase granted to employés by an award to which the Swansea Corporation was a party, resulted in some of the men receiving but a small increase, and others none at all. It was explained that this was due to the increase being applied to scheduled rates only, and some employés were already receiving more than the scheduled rates. It was decided by the Committee to grant an immediate increase of 6s. on existing rates, subject to the approval of the Joint Industrial Council.

Bulk Supplies.—The Corporation has concluded agreements with two colliery companies—Messrs. Baldwin's, Ltd. (King's Dock Works), and the Gorseinon Electric Light Co.—whereby the Corporation will provide bulk supplies of electricity for minimum charges of £6,000, £5,000, and £3,000 per annum respectively. These will involve the laying of 14 miles of cables in the Amman Valley.

Turton.—Loan Sanctioned.—The borrowing by the Urban District Council of £17,000 for electricity extensions in Eagley, Egerton, Edgworth, and Chapeltown districts, has been sanctioned by the Electricity Commissioners.

Wakefield.—Extensions.—The City Council has approved of the Electricity Committee's proposed expenditure of £100,000 on the extension of the electricity station by the installation of two 3,000-KW. turbo-alternators and accessory plant.

Walsall.—Extensions.—The Electricity Committee has recommended that a contract be entered into with the Brush Electrical Engineering Co., for supplying and fixing at the Birchells generating station, a 5,000-KW. turbo-alternator and accessories, at a price of £46,670 (subject to variation in prices of labour and materials), with the sanction of the Electricity Commissioners. It is also recommended that application be made to borrow a further £10,000 for house service cables.

Wolverhampton.—Cable Extensions, &c.—The Corporation mains and service cables are to be extended at an estimated cost of £2,955. It is also proposed to spend £1,750 in order to give a supply of energy to the Corporation Sewage Works at Barnhurst, and to lay an extra-high-tension cable to the Monmore Green Works of Messrs. Bayliss, Jones & Bayliss.

West Bromwich.—Loan.—A recommendation of the Electricity Committee to borrow £36,000 for the erection of a cooling tower, extension of mains, and other purposes, met with opposition at a meeting of the Town Council on October 6th. It was urged that at the present time there was great need for economy, and that there was difficulty in borrowing the money. The chairman, however, said that the Electricity Committee wanted to be in a position to meet any demands made upon it, and the resolution was eventually agreed to.

TRAMWAY AND RAILWAY NOTES.

Ashton-under-Lyne.—New Lines.—The Corporation has under consideration the laying of a double tramway track between Ashton and Oldham, with the introduction of a through service of cars between the two towns.

Australia.—Sydney Traffic.—In their annual report the Railway Commissioners point out that the great increase in the number of travellers on existing suburban railway lines can only be properly dealt with by the construction of electric railways or the conversion of existing lines. The annual number of passengers carried by the suburban railways increased from 77,817,452 in 1915 to 101,428,991 in the last period; the number carried by the tramways in the city and suburbs increased from 240,545,317 in 1915 to 269,255,935 for the year ended June last.

Continental.—Spain.—A very important undertaking which was delayed during the war by difficulties connected with the purchase of material, &c., is now again coming to the fore, namely, the electrification of the Pajares ascent. This section of 42 kilometres, the highest point of which is 1,270 metres above sea level, is that traversed by the North of Spain line which links up the Asturias with the rest of the country. The line is single and often blocked by snow, and it appears hardly possible to increase its usefulness by means of steam; when electricity is introduced, however, the situation will be much improved, and it will be possible to intensify the traffic and avoid the stoppages which are now so frequent, especially during the winter season. The electrification of the section will also enable the North of Spain Railway to effect considerable economy in fuel.—*Reuter's Trade Service* (Madrid).

Doncaster.—Concession to Disabled.—The Tramway Committee has decided to issue free travelling passes, renewable every six months, to local ex-sailors and soldiers who lost a leg in the war.

Women's Wages.—Women tramway conductors being still employed, the Tramways Committee has decided to advance their pay to the same level as that of the male conductors.

Halifax.—Broken Wire.—The tramway service was partially disorganised on the afternoon of October 7th, by the breaking of a wire in Commercial Street. For an hour or two the cross-town service was maintained only by passengers changing cars.

Holland (Lincs.).—Light Railway.—Plans for the construction by the City Council of 80 miles of light railway, to connect the outlying agricultural districts, at an estimated cost of £580,000, have been completed and are to be forwarded to the Ministry of Transport. The sections include:—Boston to Wainfleet; Weston to Sutton Bridge *via* Holbeach Marsh; Cowbit to Wisbech St. Mary; Dogsthorpe to Crowland; North Drive, Twenty, to Quadring; Littleworth to South Drove.

India.—Strike.—Labour difficulties at Bombay were complicated by a tramway strike on October 7th. Four hundred men demanded further pay and leave and immunity from prosecutions for cheating and struck when their demands were refused. A partial service was maintained until the afternoon, when intimidation broke it down.—*The Times.*

Leeds.—Collision.—A collision occurred, last week, between a heavy motor wagon belonging to the Northern Motor Utilities, Ltd., York, and a Leeds tramcar. The motor wagon was unable to pull up on leaving a railway goods yard in New York Street, either through failure of the brakes or because of the greasy road. The driver of the tramcar stopped his own car with great promptitude, but the wagon dashed into the front right-hand corner of the tramcar and threw the car slightly off the track, and damaged the front of it. The bonnet and front wheels of the wagon were damaged. Nobody sustained serious injury; the car conductor was slightly bruised.

Wages Increase.—The City Council, last Wednesday, decided to grant the tramway workers, 18 years of age and over, an increase of ½d. per hour on the basic scale. The increase will be retrospective to the end of March last, as in the case of many other Yorkshire towns where advances had been granted as from the date of the award of the Industrial Council.

Liverpool.—Estimated Expenditure.—The estimated expenditure on reserve, renewal, and depreciation account for the year ending December 31st, 1920, is as follows:—Renewals and alteration of tramway lines, £223,000; alterations to buildings, £9,000; alterations to cars, £4,000; car motor equipments, £40,000; overhead equipment, £2,000; contingencies, £6,000; total, £284,000.

London.—Higher Fares Result.—For the week ended October 6th, under the increased rates, the L.C.C. tramway receipts were £100,668, compared with £78,092 in the last full week under the old fares.—*The Times.*

"Underground" Improvements.—The *Daily Telegraph* states that it is expected to put the first eight-car train into service before the end of the present month. A hundred new cars have been ordered, 66 are expected before the end of the year, and the balance by next March.

Longridge.—Light Railway.—The provisional directors of the proposed Longridge—Hellifield light railway have issued an appeal for funds to carry the project through. Three years have passed since the scheme was inaugurated, and it is estimated that £300,000 will be required to complete it. Hope is entertained that the Ministry of Transport will render some assistance.

Portrush.—Power for Tramway.—In view of the fact that it is likely to be evicted from its water-power station under a recent decree of the High Court, the Giant's Causeway Tramway Co. has asked the Council to take into consideration the question of a bulk supply to the company when formulating the proposed lighting scheme.

Rochdale.—Increased Grants.—Having met representatives of Whitworth and Milnrow Urban District Councils in connection with the application for an increase in tramway charges, the Special Sub-Committee of the Tramways Committee recommends the following additional payments to the renewal funds of the Whitworth, Milnrow, and Bacup tramways, viz.:—£300 to Whitworth, £200 to Milnrow, and £240 to Bacup.

Stretford.—New Track.—An arrangement has been made between the Urban District Council and the Manchester Corporation for the doubling of the Upper Chorlton Road tramway, and linking-up Trafford Bar by making an extension along Seymour Grove.

U.S.A.—Electric Railways' Needs.—John H. Pardee, president of the American Electric Railway Association, recently stated that for present extensions and improvements and rehabilitation of existing lines and stock, the American electric railways need between three and four hundred million dollars of new capital. He estimates that the annual requirements, exclusive of the refunding obligations, amount at present to $200,000,000.

Wolverhampton. — Conversion of System. — The Corporation has accepted a number of tenders for items in connection with the conversion of the present Lorain surface-contact system to overhead, and is seeking sanction to a loan of £46,279, the estimated total cost of purchase and erection of the overhead equipment.

TELEGRAPH AND TELEPHONE NOTES.

Atlantic Cable.—British Purchase.—The directors of the Direct United States Cable Co. report that the proposals of the Western Union Co. were of such a nature as to preclude the board from recommending their consideration by the shareholders, but an offer has been received from the Government for the purchase of the company's cable, as laid, its properties, equipment, and stock cable. It is estimated that the offer, which the shareholders are recommended to accept, will, after discharging the company's liabilities, permit of a payment being eventually made of at least £6 per share; the £10 shares were quoted at 5½ — 6 last week. The income to be derived from the existing securities, and the interest upon the purchase considerations to be received from the Government will, the board believes, permit of the payment of a dividend of about 4 per cent. per annum until the company is finally dissolved.

The cable in question crosses the Atlantic from Ireland to Newfoundland, and thence to Halifax. It is 40 years old, American-owned, and has been operated by the Western Union Cable Co. since 1912. Up to the present, with the exception of the ex-German cable, which is now British-owned, all cable communication between Great Britain and North America has been under the control of the U.S.A.

Australia.—Wireless Telegraphy. — Proposals for extending commercial wireless services to Australia were explained by Sir Thomas Hughes, M.L.C., chairman of the board of Amalgamated Wireless (Australasia), Ltd., at the annual meeting of shareholders at Melbourne, and it was stated that the directors had submitted to the Government a comprehensive scheme for a direct wireless service between Australia and England. This consisted broadly in a high-speed, duplex-operated station near one of the capital cities, to communicate direct with a corresponding station in England, together with medium power-feeding stations near each of the other capital cities to pass traffic to and from the main trunk station. This system would be radically different from anything existing in Australia to-day. Both the main trunk and the feeder stations were to be operated by distant control from the heart of the cities, and all stations could communicate simultaneously with the main trunk system without interference, while the main trunk would at the same time be sending to, and receiving from, England. They had offered to handle all classes of messages at one-third less than existing rates, and to give the Commonwealth Government 25 per cent. of net profits; to have the stations working in two years; to hand them over in any time of national danger; to surrender them to the Government free of all payment at the end of a term of years, and to give the Government right of resumption at all times. Their feeder stations at the same time could cater effectively for ordinary commercial ship-to-shore traffic, thus giving an improved service for shipping and passengers, and saving the Government at least £20,000 per annum. Subject to the foregoing, the company asked that a licence be granted it, but there was nothing in its offer, nor in the conditions of wireless working, to prevent other companies having similar privileges. Sir Thomas Hughes added that the company hoped to give some demonstration of long-distance wireless telephony in Australia during the current financial year.—*Reuter's Trade Service* (Melbourne).

Cable Delays.—Considerable inconvenience is being caused by the delays in cable communication between England and the United States, which have been more or less continuous for the past week, there being four hours' delay for full-rate cablegrams and from eight to ten hours for Press-rate messages.

"Atmospheric disturbances are at the root of the trouble," a *Daily Mail* reporter was told at the Western Union Cable Co.'s offices in London. "Two of our cables are affected by the so-called earth currents on the ocean bed."

There was also delay on traffic last week between this country and Holland.

Holland.—Telegraphists' Strike.—About 200 employés at the Central Posts and Telegraphs Office and at the Bourse office at Amsterdam struck work on the 5th inst., as a protest against the delay in increasing their salaries to meet the high cost of living. A limited service was maintained, and the men returned to work the following day, but those at the Hague ceased work.

The Dutch telegraphists were to resume work on Saturday, says *The Times*, an arrangement having been arrived at between the employés and the Government.

Rumania.—Wireless Telegraphy.—Private messages can now be transmitted by wireless telegraphy between France and Rumania.—*Reuter's Trade Service* (Paris).

South Africa.—Wireless Telegraphy.—At a meeting of the S.A. Association for the Advancement of Science, at Bulawayo, it was agreed to request the Union Government to erect a wireless station of sufficient power to communicate with both Europe and North America.—*Wireless World.*

United States.—International Conference on Communications.—The International Conference on Communications, opened at Washington on October 9th, will be attended by delegates from the United States, France, Italy, Japan, Great Britain, and the Dominions, who may be expected to sit for at least a month. Its work is likely to fall into two main parts, says *The Times*—the disposal of captured German cables, which will presumably be more or less definitive, and preparation for a General International Conference upon Communications, to be held later. The latter task will presumably mean much discussion of the technical regulation of wireless systems, provisions to help the international news service, and so forth. At least, that seems to be the expectation of those Americans who are taking a leading part in the preparation of the programme. The Americans, according to statements given by the Government to the Press, have definite views about the ex-German cables and the general control of ocean telegraphs. Their delegates, headed by Mr. Burleson, the Postmaster-General, and Admiral Benson, the head of the Shipping Board, are said to be particularly interested in the ex-German cables across the Atlantic, one of which was taken into Halifax during the war, and has since the Peace Conference fallen to the share of Canada, while the other now connects France and the United States. American commercial interests are said to have been pressing them to try to secure one of these lines so as to give them better facilities for direct communication under American auspices with Europe. Complaints, reminiscent of American impatience with our cable-censorship during the first phase of the war, are being made that the British Government, by virtue of its control over our telegraphs, it still able to tap American telegrams. Interest with regard to the Pacific centres upon the island of Yap. This is the cable station touched by the lines between the United States and her Eastern possessions, and as an outcome of the debate in the Senate on the Peace Treaty last year there is such strong opposition to the allotment of the island to Japan, as is provided for by the Peace settlement, that its internationalisation may be proposed.

It is unfortunate, in view of all this, that the meeting of the Conference, which has already been postponed several times, could not have been again put off until after the Presidential election. Discussion of British cable control, and especially the disposal of the ex-German cables, may tend to give ammunition to the professional anglophobes. Too much must not, of course, be made of that sort of thing. In the interests, however, of future international co-operation, and especially of the possible participation of the United States in the League of Nations, it is, perhaps, a pity that an International Conference which the American Press advertises as containing the germs of controversy should be meeting in such surroundings, says *The Times*.

Wireless Telegraphy.—The Westinghouse Co. announces that it now controls the International Radio Telegraph Co., which is conducting ship-to-shore communication on the Atlantic Coast. The Westinghouse Co. also proposes to erect a high-power trans-Atlantic station.—*Reuter's Trade Service* (New York).

Wireless Direction Finding.—Lizard Station.—An Admiralty notice to mariners states that the Lizard Wireless D.F. Station was re-opened at midnight on September 9th-10th.

CONTRACTS OPEN AND CLOSED.

(The date given in parenthesis at the end of the paragraph indicates the issue of the Electrical Review, *in which the "Official Notice" appeared.)*

OPEN.

Australia. — Commonwealth Government. November 24th. Protected cable terminals and cable distribution boxes.

Queensland.—November 24th. P.M.G.'s Department. Iron poles (schedule 506), protected cable terminals, cable distributing boxes (schedule 507).

November 30th. P.M.G.'s Department. Protectors (schedule 505). (September 24th.)

Brisbane.—December 9th. Department of Public Works. Seventy three-phase oil-cooled core-type static transformers.

November 23rd. P.M.G.'s Department. Telephones and telephone switchboard parts. (October 8th.)

January 20th, and February 25th, 1921. The City Electric Light Co. 10,000-kw. turbo-alternator set; transformers and switchgear.

MELBOURNE.—February 24th, 1921. The Victorian Electricity Commissioners. Turbo-alternators of 25,000, 12,500 and 600 KW., and other plant connection with the Morwell power scheme.

NEW SOUTH WALES.—November 25th. P.M.G.'s Department. Telegraph and telephone instrument and switchboard parts (schedule 753).

SOUTH AUSTRALIA. — October 20th. P.M.G.'s Department. Telegraph instruments (schedule 546), and telephone instruments (schedule 549). (September 10th.)

November 3rd. P.M.G.'s Department. Telephone instruments (schedule 548). (September 10th.)

November 11th. P.M.G.'s Department. Telephone instruments (schedule 547). (September 24th.)

WESTERN AUSTRALIA.—December 28th. Postmaster-General's Department. Telegraph and telephone instruments and parts. Schedule 689.

Belgium.—October 26th. The Société Nationale de Chemins de Fer Vicinaux, 14, Rue de la Science, Brussels, is inviting tenders for the laying of the underground armoured cables necessary for feeding the Namur-Citadelle-La Plante railway. Particulars may be obtained from the Electrical Department (Services Electriques) of the company, at 48, Rue Monteyer, Brussels.

November 3rd. Municipal authorities of Hognoul (Province of Liége). Concession for the supply of electrical energy for lighting and power purposes in the town.

November 9th. Municipal authorities of Antwerp. Electrical plant for driving the pumps used for emptying the Nattendijck dry dock. Copies of the specification can be obtained for 3 fr. from the Hotel de Ville, Antwerp.

Bradford. — October 28th. Electricity Department. Two natural-draught chimney-type cooling towers, pipework troughing, valves, &c. (Contract R 160). (September 24th.)

Costa Rica.—The Government of the Republic of Costa Rica, Central America, is at present inviting tenders for the concession for the construction and working during a period of 50 years of an electric tramway between the towns of Alajuela and Grecia. The Government will guarantee during the first 25 years of the concession, from the date of the opening of the line, an annual interest of 6 per cent. on a capital not exceeding one million colons. The water necessary for the generation of electrical energy will be supplied free; the necessary material and plant will be admitted free of import duty, the necessary land on the public highways will be provided without cost to the concessionaires, while the undertaking will be exempt from taxation during the whole period of the concession. Further particulars can be obtained from the Consul-General of Costa Rica, M. Camille Marchant, 10, Avenue Hamoir, Brussels, Belgium.

Denny (N.B.).—October 18th. Electric lighting work at Anderson Street site (No. 2). Mr. J. Strang, architect, Falkirk.

Indo-China.—January 3rd, 1921. Generating station at Gia-Lam; pumping station at Dong-Du on the Red River; electric line between above stations. Agence Générale des Colonies, Pièce 21, 2e étage, 27, Rue Oudinot, Paris.

India. — AGRA. — October 22nd. Municipal Board. Complete generating plant. (August 20th.)

London.—LONDON COUNTY COUNCIL.—October 25th. 125 tramcar bodies, 125 complete sets of maximum traction bogie trucks, and 125 electrical equipments, together with the assembling of same. (October 1st.)

Manchester. — October 20th. Electricity Committee. Specification No. B.9. Five 8,500 K.V.A. 3-phase transformers and fans, &c.; and three 6,000 K.V.A. 3-phase transformers and fans, &c. Mr. F. E. Hughes, Secretary, Electricity Department, Town Hall.

October 20th. Board of Guardians. Induced draught fan with electric motor complete, for use with steam raising plant at Withington Institution, West Didsbury. Mr. Hargreaves, superintendent of works, Union Offices, All Saints.

October 27th. Electricity Committee. Complete heating installation for the workshop and stores at the Barton power station. Mr. S. L. Pearce, Chief Engineer and Manager, Dickinson Street.

October 27th. Electricity Committee. Three mechanical water screens, and three grid screens. (Specification B. 10.) (October 1st.)

November 8th. Electricity Committee. Supply and erection of high and low pressure steam, feed, &c., pipework—including alterations to existing pipework, &c. (See this issue.)

Turton. — November 10th. Urban District Council Electricity Committee. Overhead lines and underground cables. (See this issue.)

Ramsgate.—Town Council. Electric lighting installation, Council chamber; Borough Engineer.

Spain.—November 20th. The Spanish Ministry of Public Works in Madrid is inviting tenders for the concession for the construction and working of an electric tramway between Los Canos and San Fausto de Chapela, near Vigo. The adjudication is practically only a formal matter, the line forming an extension proposed by the Vigo Electric Tramways Co.

The local authorities of Daimiel (Province of Ciudad Real) recently invited tenders for the purchase of the municipal electric lighting undertaking in the town, and for continuing the service as a private enterprise.

Uruguay.—December 18th. The Post Office authorities are, for the second time, inviting tenders for the construction of an underground telephone system.

West Hartlepool.—October 26th. Electricity Department. One 1,000-KW. rotary converter and switchgear. (October 8th.)

CLOSED.

Batley.—Waterworks Committee. Electric pump or booster at Cooper Bridge, with delivery capacity of 2,000,000 gallons per day; Holden & Brooke.

Bolton.—The Electricity Committee. Water-screening plant at Back-o'-th'-Bank generating station. Messrs. F. W. Brackett & Co., Ltd.

Bradford.—Electricity Committee. 10-ton overhead travelling crane. Herbert Morris, Ltd., Loughborough.

Dartford.—Urban District Council. Installing electric light at 28 houses, Lowfield Street. W. Bayliss. £7 per house.

Doncaster.—Town Council:

High-tension switchgear.—Reyrolle & Co., Ltd., £5,410.

London.—L.C.C. Highways Committee. The following tenders have been accepted during the recess:—

Steelwork required in connection with the completion of the centra repair depôt.

E. C. & J. Keay, Ltd. (accepted)	£45,589
A. D. Dawnay & Sons, Ltd.	48,202

1,500 tons of conductor rails for tramway purposes:—

Frodingham Iron and Steel Co., Ltd.	£50,425
Partington Steel and Iron Co., Ltd.	52,500*
D. Colville & Sons, Ltd.	69,550

* On truck, Manchester.

Wolverhampton.—Town Council. Conversion of the tramways from the Lorain surface-contact system to the overhead system. Among the principal tenders accepted, are the following:—

Steel poles, £24,542.—British Mannesman Tube Co., Ltd.
Cast-iron pole bases and finials, £4,911.—W. Boydell & Sons.
Trolley standards and bases, £683.—Brecknell, Munro & Rogers, Ltd.
Globe strains, hanger bolts, section insulators, &c., £1,546.—A. Wiseman, Ltd.
Trolley wire, £4,392.—Thos. Bolton & Sons, Ltd.
Approximate cost of labour for erecting poles, £1,596.

Tramways Committee. Accepted:—

Tipping wagon, £168.—Fleming, Lowder & Co.
Special work at Bakers Loop, £324, and in connection with the new car-shed, £2,690.—Hadfields, Ltd.

FORTHCOMING EVENTS.

Royal Society of Arts.—Friday, October 15th. At John Street, Adelphi. At 4.30 p.m. Lecture on "British Trade with India," by Mr. T. M. Ainscough, H.M. Senior Trade Commissioner in India and Ceylon.

Commercial Motor Exhibition, Olympia, W.—October 15th to 23rd.

Chief Technical Assistants' Association.—Saturday, October 16th. At Anderton's Hotel, Fleet Street, E.C. At 3 p.m. Paper on "Refuse Destructors," by Mr. A. Murdoch.

Electrical Power Engineers' Association.—Saturday, October 16th. At the Christian Institute, 70, Bothwell Street, Glasgow, at 7 p.m. General Meeting address by Mr. J. W. Thomas, assistant general secretary.

Electricity Supply Commercial Association (Greater London Division).—Monday, October 18th, at Caxton Hall, Westminster. Mass Meeting.

Batti-Wallahs' Society. — Monday, October 18th. At 1 p.m. At the Holborn Restaurant. Lunch; also some uplifting "electric" remarks from Mr. H. E. Blain.

Institution of Electrical Engineers (Western Centre).—Monday, October 18th. At the South Wales Institute of Engineers, Cardiff. At 7 p.m. Annual general meeting.

Institution of Engineers and Shipbuilders in Scotland. — Tuesday, October 19th. At the Rankine Hall, Glasgow. At 7.30 p.m. Presidential address.

Edinburgh Electrical Society.—Thursday, October 21st. At 7.30 p.m. Visit to *Scotsman* offices.

Association of Engineering and Shipbuilding Draughtsmen (York Technical Section).—Thursday, October 21st. At Priory Street Higher Grade School, York. At 7.15 p.m. Paper on "The Destructive Distillation of Coal," by Mr. E. Nicholson.

Chelmsford Engineering Society. — Thursday, October 21st. At the East Anglian Institute of Agriculture. At 7 p.m. Paper on "Electric Traction," by Mr. E. H. Field.

Institution of Mechanical Engineers.—Friday, October 22nd. At the Institution, Storey's Gate, S.W. At 6 p.m. Address by the President.

Junior Institution of Engineers.—Friday, October 22nd. At 39, Victoria Street, S.W. At 8 p.m. Paper on "Impulse Turbines," by Mr. A. H. Fitt.

Paisley Association of Electrical Engineers.—Wednesday, October 20th. At the Technical College, George Street. At 7.30 p.m. Presidential addr. ss by Mr. W. R. Bruce.

Manchester Association of Engineers. — Saturday, October 23rd. At the Memorial Hall, Albert Square, Manchester. At 7 p.m. Paper on "Vibration, including that of Crank Shafts, Fly Wheels and Alternating-current Generators," by Mr. J. Frith.

Birmingham and District Electric Club.—Saturday, October 23rd. At the Grand Hotel, Colmore Row. At 6.30 p.m. Annual ladies' night.

NOTES.

The Osram Patents.—In the Chancery Division on Wednesday, October 13th, Counsel applied to Mr. Justice Eve, in the action of the Osram Lamp Works, Ltd., *v.* Maxim Lamp Works, Ltd., for judgment in default of defence. The case related to an alleged infringement of one of the plaintiff company's patents. Judgment was given accordingly.

Copper and Lead Prices.—Messrs. F. Smith & Co. and Messrs. James and Shakespeare report, October 12th, no change in last week's copper prices. English pig lead £35 10s., a reduction of 10s. on last week's quotation.

Removing Sand from Water.—A description is given in *le Génie Civil*, of October 2nd, of a device perfected by M. Henri Dufour, a Swiss engineer, for continuously removing sand from water in hydro-electric works, to prevent the serious wear which is caused by its passage through the turbines. The apparatus consists of a series of parallel compartments furnished with baffle-plates to prevent rapid motion of the water, which enters at one end at the bottom, and after traversing the compartments, escapes at the other end at the top. The sand and gravel fall to the bottom of each compartment, which is funnel-shaped; at the apex of the funnel a hole is provided through which a small quantity of water constantly escapes, carrying with it the deposits. Thus the compartments are automatically cleared of sand.

The device has been installed at a power station in Chile, where grave damage had been done by sand; an improved form has since been adopted at a Swiss works.

Theft of Radium.—A safe, which contained, amongst other things iridium, gold, radium bromide, and platinum, was stolen, on the 5th inst., from the premises of Messrs. Golodetz, in the City. The bottle containing the iridium sponge is said to have contained 24 oz. troy, which is stated to be worth £120 per oz.

Educational.—MUNICIPAL COLLEGE OF TECHNOLOGY, MANCHESTER.—The recently-published prospectus of University courses is a very complete description of the College, its aims and scope, and the courses are very minutely detailed. The degree courses leading up to the grant of the B.Sc.Tech. and M.Sc.Tech. cover the following fields:—Mechanical, electrical and sanitary engineering, applied chemistry, textile industries, architecture and mining. Part-time day and evening courses are also scheduled.

RAMSAY FELLOWSHIP.—A Ramsay Memorial Fellowship of the value of £300 a year for three years has been founded by subscriptions received from the Swiss Government and from Swiss donors, through the good offices of Prof. Ph. A. Guye, of Geneva. The first Fellow to be elected is M. Etienne Roux, of Vich (Vaud), Switzerland, who has decided to work in the laboratories of Prof. W. H. Perkin, at Oxford.—*The Times.*

At a luncheon given at the University of Birmingham on October 8th, Mr. Austen Chamberlain said that it was the Government's intention to increase the grant in aid of University education by £500,000, making a total of £1,500,000, and unless overwhelming financial conditions prevented it, the same sum would be given for a number of years. Mr. Chamberlain said that up to the present immense sums had been spent on elementary and secondary education, and too little upon Universities. The grant would be administered by the committee presided over by Sir William McCormack, but the Government should not interfere too much, and the Universities must retain their independence.

WHITWORTH EXHIBITIONS.—The Board of Education announces that the following candidates (among others) were successful in the 1920 competition for Whitworth Exhibitions:—William A. Rowe, electrical fitter apprentice, Plymouth Dockyard; Charles J. Manning, electrician apprentice, Portsmouth Dockyard; Archibald G. Woodhouse, electrical fitter apprentice, Plymouth Dockyard; and Reginald W. Stubbington, electrical fitter apprentice, Portsmouth Dockyard.

L.C.C. GRANTS.—Among the larger grants made by the L.C.C. to technical institutions for the purchase of equipment during the year 1920-21 are the following:—£4,000 to the Battersea Polytechnic; £3,500 to the Northampton Polytechnic; £3,000 to the Regent Street Polytechnic; £2,300 to the Goldsmiths' College; and £2,150 to the Woolwich Polytechnic.

Lloyd's Register of Shipping.—The report of the Society's operations for the year ended June 30th, 1920, which has just been issued for the first complete year since the cessation of war, contains very interesting information relating to shipbuilding at home and abroad, and also to the use of oil fuel for boiler firing and oil engines on board ship. The Committee has recently approved amended rules for electrical fittings on board vessels. The Society's chief surveyors were members of the "Ships' Electrical Equipment Committee" of the Institution of Electrical Engineers, which dealt with the recent revision of the Institution's requirements for the electrical equipment of ships, and the Society's amended rules are in accordance with the latest requirements of the Institution. The chief ship surveyor is a member of the Standing Sub-Committee appointed by the Institution of Electrical Engineers to consider the interpretation of the rules drawn up by the "Ships' Electrical Equipment Committee." The Committee has acceded to the request of the Institution of Engineers and Shipbuilders in Scotland that Dr. Montgomerie, the Society's principal surveyor for Scotland, be allowed to act as one of the representatives of the Institution on the British Engineering Standards Association Technical Committee on the standardisation of details in the construction of ships and their machinery.

Scandinavia and the Export of Energy.—The question of the export of electrical energy has been under discussion in Scandinavian countries for some time past, with particular reference to deliveries from Norway to Sweden, and from both these countries to Denmark, whose water-power resources are insignificant. In Denmark the idea of receiving power from Norway and Sweden as suggested by a Swedish engineer (Mr. Hjalmar Cassel) has created great interest, and a Committee has been appointed and made application to the Norwegian Government for the establishment of a Norwegian Committee to co-operate with the Danish Committee in the matter. As to the position in Sweden, the principal of the State hydro-electric department is reported to have stated some time ago that Sweden had an adequate supply of power available for the immediate future, and that there could, therefore, be no question of importing energy from Norway unless it were materially cheaper, but this could scarcely be expected to be the case. But even if Norwegian power was provisionally obtainable at a lower price, he said that it was preferable for the Swedes to base their distribution of power and industry upon their own waterfalls, as a supply of power which could be relied upon was cheaper in the long run than power obtained from another country. In this connection a Norwegian engineer (Mr. R. Kraabol-Jorstad) points out that out of the Norwegian water powers representing about 10,000,000 KW., only 1,100,000 KW. had been brought into service by the end of 1919. He states that the power already available is relatively cheap, but will become more costly in the case of new works. The export of power in the near future is not advisable, in his opinion, from a national economic point of view, owing to the existing great scarcity of power, and the large expenditure which would be needed for machinery and plant. The opinion in Sweden was that the Swedes could manage very well without Norwegian power as the requirements in the south could presumably be entirely covered on the regulation of the Vanern in connection with the extensions proposed at Trollhattan. On the other hand, the Swedes were not unwilling to transmit power from Trollhattan to Denmark, with the aid of a line from Trollhattan to Skaane.

Electricity in a Mint.—To increase the output of minor coins, the United States Mint at San Francisco is installing a Rennerfelt electric furnace of 1,000 lb. capacity, operating on two-phase, 60-cycle service transformed from 2,200 volts to 110 volts. The furnace was originally in operation at the Philadelphia (Pa.) Mint, and was only recently withdrawn from service there when replaced by furnaces of more recent design and greater capacity. It is hoped to have the furnace in operation by the end of September, but this may be delayed through uncertain delivery of certain electrical switching equipment. Only metal for pennies and nickels will be melted in this furnace, silver being handled in the oil-fired crucibles now in use. Several of these crucibles were taken out to make room for the electric furnace, while considerable construction work was necessary to accommodate the new equipment. A motor-driven topping machine and a motor grinder will be installed to handle the clipping and smoothing of the ingots, and a mechanical conveyor will eliminate most of the heavy carrying of the moulds now done manually.—*Journal of Electricity.*

Electricity in Mines.—Mr. J. R. R. Wilson, H.M. Inspector of Mines for the Northern Division, in his report for the year 1919, states that there were no underground fatalities, and only four non-fatal accidents, due to electricity, and, considering that the use of electricity underground increased from 79,422 H.P. in 1913, to 122,051 H.P. in 1919, this cannot be regarded as unsatisfactory.

The Batti-Wallahs' Society.—The following is the programme for 1920-21 session:—

Monday, October 18th, 1920.—Lunch.
Wednesday, November 3rd.—Informal evening.
Monday, November 15th.—Lunch.
Friday, December 3rd.—Smoking concert.
Monday, December 20th.—Lunch.
Wednesday, January 5th, 1921.—Informal evening.
Monday, January 17th.—Lunch.
Wednesday, February 2nd.—Informal evening.
Monday, February 21st.—Lunch.
Wednesday, March 2nd.—Informal evening.
Monday, March 21st.—Lunch and annual general meeting.
Friday, April 1st.—Annual dinner.
Monday, April 18th.—Lunch.
Monday, May 9th.—Lunch.
Monday, June 20th.—Lunch.

At the Holborn Restaurant, on Monday, October 18th, Mr. H. E. Blain will give an address.

Measuring Coal-Stack Temperatures.—An instrument for ascertaining the temperature of a coal-stack at various depths, was recently described by *Power*. The apparatus, known as the "Thornley Coalometer," consists of three tubes extending to various depths and enclosed in a long, pointed steel case. These tubes end in bulbs, and are filled with alcohol. At the upper end of the instrument are three dial temperature indicators each connected to a tube. The scale on each dial runs from 32° to about 200° F., it is coloured black up to 120°, but upwards from that temperature the colour is red, indicating excessive heat. If several of these devices are forced into a coal pile at varying depths and in different localities, very accurate information can be gathered for the whole of the pile. Instruments employed at intervals of 50 ft. have proved very effective.

Coal Getting by Machinery.—Interesting details regarding the extent to which mechanical coal-cutters are used in Scottish pits, and the growing preference for electricity, are supplied by Mr. H. Walker, Chief Inspector of Mines for Scotland, in his annual report. There was an increase of 108 in the number of coal-cutting machines at work, and of 177,364 tons in the quantity of mineral obtained by them compared with the figures for 1918. The total quantity of mineral cut by mechanical coal-cutters was 10,379,495 tons, of which 9,507,912 tons were got by machines driven by electricity, and 871,583 tons by machines driven by compressed air. A comparison with the figures for 1913 shows that 313 more machines were employed, and 1,044,043 tons more obtained by this means in 1919 than in 1913. In 1919 there were 353 more electrically-driven coal-cutters at work than in 1913, and 40 fewer driven by compressed air. The number of mechanical conveyors in operation at the working face during the year was 105, compared with 125 in 1913. Regarding accidents, Mr. Walker recommends the introduction of a practical electric head lamp.

The Threatened Strike in Power Stations.—We have received from Mr. E. J. Jennings, secretary to the District Industrial Council for Electricity Supply Industry No. 5 (West Midlands Area), 14, Dale End, Birmingham, a copy of the following letter, dated October 9th, which he has circulated amongst the District Councils for the Electricity Supply Industry :—

"I beg to inform you that at a meeting of my Council yesterday, the circumstances under which the Electrical Trades Union had threatened in connection with the recent Penistone dispute to withdraw the labour of its members employed in electric supply undertakings were discussed. The chairman reported the steps he had taken in the matter, and, as the outcome of the discussion, it was resolved unanimously, on the motion of the chairman (Employers' side), seconded on the Trade Union side :—

"That, in view of the recent threat to withdraw labour from the electric supply undertakings arising out of an extraneous labour dispute, this District Industrial Council is strongly of opinion that it should first be given an opportunity by the parties concerned to consider, before action is taken in any matters affecting the relations between employers and employés."

Nickel-plating Aluminium.—According to a note presented by M. Le Chatelier to the Académie des Sciences, published in *La Technique Moderne*, Messrs. Léon Guillet and Maxime Garnier have solved the difficult problem of depositing nickel on aluminium. The surface of the metal is first sand-blasted, with sand that has passed through a sieve with 0·2-mm. meshes, under an air pressure of 1,500 gm. per cm². A deposit of nickel 0·006 mm. thick is then made, with a current of 0·8 ampere per dm² for half-an-hour, after which a coating of copper is applied, 0·02 mm. thick, the operation lasting two hours with a current of 1 ampere per dm². The copper is then polished, plated with nickel 0·005 mm. thick (0·5 ampere per dm² for one hour), and the nickel is polished. This process gives a smooth adherent coating, passing mechanical and chemical tests, and not only ensures the durable protection of the aluminium, but also enables it to be soldered by the ordinary processes. The nickel bath consists of sulphate of nickel, 150 gm., double sulphate of nickel and ammonia, 50 gm., water to 1 litre; the copper bath of copper sulphate, 150 gm., sulphuric acid, 20 gm., water to 1 litre.

The Engineering Training Organisation.—Following the unsuccessful attempt to place the E.T.O. scheme on a satisfactory financial basis, the Federation of British Industries, recognising the importance of its activities and to prevent its dissolution as a separate organisation, offered to take over the work; a similar offer was also made by the Engineering Employers' Federation. A conference of representatives of the three organisations was, therefore, held, at which it was agreed to entrust the scheme to the Engineering Employers' Federation. It is to be hoped that under the new auspices, the work will so develop as to enable the young engineer to obtain such training as will uphold the prestige of British engineering practice throughout the world.

Wireless Ship Control.—Tests of a wireless control installation on the old battleship *Iowa*, just concluded by the U.S. Navy Department, off the Virginia Capes, are declared to have fulfilled the highest expectations of naval experts. The 12,000-ton battleship was navigated with precise accuracy, it is said, solely by means of wireless telegraphy from a control station on the battleship *Ohio*. The control was found thoroughly efficient up to a maximum distance of 10 or 12 miles.—*Reuter's Trade Service* (Washington).

Appointments Vacant.—Two station engineers for Egypt, for the Air Ministry; lecturer in electrical and mechanical engineering, for the Wigan and District Mining and Technical College; switchboard attendant (90s.), for the City of Chester Electricity Works; engineer and secretary, for the Wadebridge and District Electric Supply Co., Ltd.; assistant charge engineer, for the Egham and Staines Electricity Co., Ltd.; meter tester, for the Stoke-on-Trent Electricity Department; tramway overhead linesman (38s. 8d. + 40s.), for the Wigan Corporation Tramways; assistant for small D.C. station, for the Sale U.D.C. Electricity Department; visiting teachers in electrical engineering, physics, and electrical wiring, for the L.C.C. Institute at Hackney; plumber-jointer (£5), for the Borough of Heywood Electricity Department; plumber-jointer and two linesmen, for the Gellygaer Urban District Electricity Department; telegraph engineering assistants (£350 + 50 per cent.), for the Post and Telegraph Department of the Government of Tanganyika Territory; telegraph engineers (£480), for the Governments of the Gold Coast and Nigeria; foreman linesman and overhead linesman, for the Burnley Corporation Tramways Department. See our advertisement pages to-day.

Scintillations from "The Electron."—*The Electron* is the journal issued by the London District Committee of the Electrical Trades Union; in its issue No. 3, for October, a number of interesting items appear, of which, perhaps, "Ole Bill's Summary" is the spiciest. From this we gather that at a meeting of the Film Workers' Union on September 16th, Mr. F. J. Rosenburg remarked that "The Workers' Union had decided that its members should stay at work even if the E.T.U. did come out. He pointed out that the Workers' Union was quite justified in taking this step, as they had nothing whatever to do with the foreman at Penistone, about whom all the trouble was. He pointed out that the E.T.U.'s threat to cut off London's electricity supply was impossible, as all the stations were controlled by the Workers' Union members." This quotation was originally derived from *The Kinematograph*. It suggests that the Workers' Union bases its decision to strike, or not to strike, purely on the merits of a dispute in which another Union is engaged. The claim that in the London stations, members of the Workers' Union predominate is, we believe, well founded, though "Ole Bill" throws scorn upon it, and expresses his opinion of that Union in unequivocal terms: "The Workers' Union is a blacklegging organisation, and ought to be hounded out of the Trade Union movement as a danger to working-class organisation." Possibly the Workers' Union reciprocates this amiable sentiment—it did its utmost to avert the strike when that was pending. On the other hand, "Ole Bill" is kindly disposed towards the E.P.E.A., in spite of the hard things which he admits having uttered with regard to it; he says: "The action of the E.P.E.A. in the engineering dispute has been straight and above-board, and above anything else, I do love a square deal." He cites the case of Colchester, where the Town Council has refused to pay the rates agreed upon by the District Council, and also refused to pay the E.P.E.A. agreed advance of £30. Both organisations took joint action, and tendered notices to expire at the same time. The matter has been referred to the Industrial Court for settlement. This is the first occasion on which both organisations have acted together, and they both have our hearty sympathy; Councils (and companies) which refuse to honour the decisions of the Industrial Council and Joint Board are not only asking for trouble for themselves, which will be duly delivered, but also are disturbers of the peace, and as such are enemies to the public welfare. The last words of "Ole Bill" (*i.e.*, Mr. W. J. Webb) are: "We ARE going to control the electrical industry."

By a remarkable slip of the pen, on p. 15, our lively contemporary arrives at an increase in the cost of living of 182 per cent. above pre-war, by *adding* a 30 per cent. increase in rent to the value 152 per cent.

South African Power Scheme. — Kimberley and its surrounding mines have long attracted the interest of engineers as a centre for the consumption of a cheap power supply, and the Government Inspector of Machinery for the district in his last annual report says he believes that a scheme is on the tapis to erect a power station at the Kroonstad Colliery, and transmit the power generated there through the O.F.S., by way of Boshof, Koffiefontein, and Jagersfontein. A line, either direct or branch, will, of course, come to Kimberley. This scheme, if decided upon, will have far-reaching effects in the industrial development of a huge tract of country at present almost entirely devoted to pastoral pursuits. Such a scheme is of first importance to the Kroonstad Colliery Co., whose product, as a steam coal, is of low quality, and therefore cannot hope to compete in the open market with the higher class coal of the country except at points at and close to the mine. The scheme is capable of expansion, and would, it is thought, be a strong factor, if developed to its full capacity, in liberating much of the latent wealth of this district. There is a plentiful supply of good water available within five miles of the mine, a weir across the Vaal being all that is necessary to ensure the supply being permanent. From its inception the financial success of the scheme is assured. De Beers Consolidated Mines, Ltd., even on that company's present electric requirements, would consume approximately 8,000 KW. New Jagersfontein would require almost as much, as cheap power would be a strong incentive to that company to centralise on a direct-treatment plant to deal with the whole of the ground mined. Koffiefontein Diamond Mine, Blaauwbosch Diamonds, New Eland Diamonds, Roberts Victor Diamonds, and Kimberley Waterworks, all on the route, would, it is thought, require approximately 2,000 KW. to satisfy their requirements. An electric railway from Koffiefontein to Fourteen Streams or Vierfontein would be brought within the range of possibility were such a scheme as that under consideration an accomplished fact. To further elaborate this proposition and its possibilities for the future, it might easily prove the deciding factor of the establishment of an iron industry at or near Postmasburg. If that came to pass, it would in its stride supply power to the Frank Smith Diamond Mines. The Makganyene Diamond Syndicate could also be supplied, and possibly some of the small asbestos ventures near which it would pass. The extraction of nitrogen from the air for agricultural purposes could also be undertaken, if for no other reason than to stabilise the load and extend the peak over 24 hours. The approximate distance of transmission lines from the generating station to the furthest point of supply will be 300 miles. This would be easy of accomplishment now that systems up to 100,000 volts are capable of reliable operation. The potential drop over such a system should not be greater than 4 per cent.—*S.A. Mining and Engineering Journal.*

Railway Electrification.—Six years ago it was just beginning to be realised that suburban railways were not the only ones which it might pay to electrify, and that in many cases the possible increase of traffic was not the only or even the most important factor. The reduction in operating costs, both in the locomotive and traffic departments, which electrification rendered possible, was, it was found, sufficient to justify the conversion of lines where no special increase of traffic was to be expected. The war postponed a number of projects which were being prepared, and the great increase in capital cost is still holding up a number. On the other hand, the cost of operating steam locomotives has also increased to such an extent that even at present-day prices of electrical apparatus several new important schemes are on the way. This particularly applies in Central Europe, where the cost of coal has become almost the dominant factor. In France, Switzerland, and even in Austria, the conversion of various lines from steam to electric working looks like going ahead. The extent of the possible economies may be judged from the case of the lines from Innsbruck to the Swiss frontier where, according to one of the American Government experts, there will be a direct annual saving of 150,000 tons of coal, and a further 16 per cent. saving in the amount of coal formerly required for transporting the railways' own coal. In view of the changed conditions to-day, both as regards locomotive and traffic expenses, it may be desirable to reconsider the question of electrification in connection with various lines where it has hitherto proved impracticable.

The pros and cons of electric *versus* steam traction were discussed recently by railway engineers and others gathered for the purpose of hearing a paper entitled "Electric Traction for Railways." It was remarked by one speaker that with the continued rise in the cost of coal, and the urgent necessity for conserving it, anything which tended to reduce coal consumption must be considered favourably, so that from this point of view electrification undoubtedly scores a good point because an up-to-date power station can produce electricity at less than 2 lb. of coal per B.O.T. unit. This energy, after being transmitted to the sub-stations, transformed down and converted to D.C. and fed to the train motors—the overall efficiency from the power station busbars to the rim of the driving wheels of the electric train being about 62 per cent.—gives one B.O.T. unit per 3.2 lb. of coal, or 1 H.P.-hour for 2.4 lb. of coal. From a test of a steam passenger train, it requires from 6 to 8 lb. of coal to be burnt in the locomotive firebox per H.P.-hour, delivered at the tender drawbar, for express running. With goods trains, of course, the consumption is considerably less, being about 4 lb. At any rate, there is ample margin here for coal economy to be effected.

While the advantage of moving trains by electric power is recognised, the expense of electrification projects prevents many desirable schemes from maturing. As, however, traffic is bound to grow very considerably as time goes on, the question has been asked whether too much emphasis is not laid upon the first cost. The American *Railway Electrical Engineer* points out that by 1930 the movement of freight on many lines will have grown to such an extent that continued operation by steam power will be quite impossible, except by increasing the number of tracks. It is therefore suggested that the railway problem to be decided is whether it will be cheaper to build these additional tracks and to maintain them some ten years from now, or, alternatively, to spend the same amount of money on electrification to-day and enjoy the advantages of improved operating facilities. Investigations have proved that one electric locomotive can exert a greater drawbar pull than two of the largest steam locomotives, and there is practically no limit to the power of the former, while the latter has almost reached its maximum. At the same time it must be remembered that while electrification has justified itself in certain districts, it is by no means certain that the general changeover would be economical. It is probable that the report of the special committee appointed by the Minister of Transport to investigate this question will prove very instructive in this regard.—*Railway Gazette.*

A Portable Oscillograph.—An illustrated description of a portable oscillographic outfit appears under the name of Mr. J. W. Legg, of the Westinghouse Electric & Manufacturing Co., Ltd., in the *Journal* of the A.I.E.E. for July, 1920. Briefly summarised, the special features of this portable commercial oscillograph are as follows: The apparatus, including the series electromagnet galvanometer, is very compact, and use is made of an incandescent lamp with special arrangements to obtain very great intrinsic brilliancy. A mechanically-operated focal-plane shutter is provided, which always starts exposures at the beginning of the film, in addition to a remote-control switch to cause transient phenomena to appear at any desired point. This switch and the shutter are operated by a trip magnet immediately after abnormal voltage is applied to the incandescent lamp, and to prevent the filament of the latter being destroyed a lamp-extinguishing switch is also fitted. A self-contained storage battery supplies the galvanometer field, and there is a switch for placing the ammeter in the galvanometer field or battery-charging circuits; the element resistances and control panel are capable of standing commercial voltages. All the above apparatus is mounted in a single case, the dimensions of which are 13 by 14 by 25 in. overall, and its weight 82 lb. An induction motor with back gear and step pulley arrangement drives the photographic drum at a uniform speed over a large range of speeds; a transformer for 110 or 220 volts, 20 to 70 cycles, supplies the motor, lamp, and trip magnet circuits, and separate switches are provided for the control of the motor, transformer, and lamp. The whole of this portable commercial oscillograph is arranged in two units, which together weigh 135 lb., including the storage battery and transformer.

Novel Commutator Construction.—A contributor to *Power* tells how the commutator of a small generator was made from solid copper. The dimensions of the commutator had to be 2¼ in. dia. and 2 in. long. A piece of copper rather over this size was obtained, and a hole a little smaller than the diameter of the armature shaft was bored through it. The metal was then fixed on a mandrel and placed in a lathe, and the back gears of the latter being used for a dividing head, the slots were marked off. The blank was then taken off the mandrel, and saw cuts were made to within 1/32 in. of the bore. These slots were filled with mica, and a pipe was bored

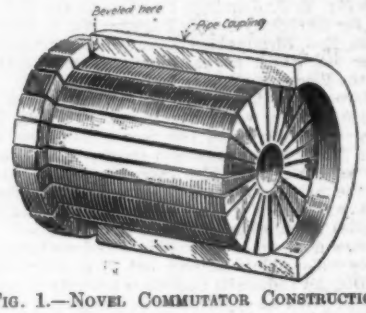

FIG. 1.—NOVEL COMMUTATOR CONSTRUCTION.

out to fit tightly over the outside of the commutator (fig. 1). The whole was then mounted in the lathe and bored out to correct size, cutting away the small portion of metal left to hold the blank together. The bore was then cleaned out and the commutator mounted on a mandrel and turned to receive the clamping rings. After mounting the commutator on the armature shaft the pipe coupling was pulled off and the face turned down to a finish.

INSTITUTION NOTES.

Bradford Engineering Society.—At the opening lecture of the new session of the Society (Lieut.-Colonel Gadie presiding), Mr. C. K. Everitt, of Sheffield, spoke on steel-making processes. After giving the history of steel-making and describing various processes, Mr. Everitt said the electric furnace had played a very important part during the war in the manufacture of alloy steel for motor transport and aircraft. The speaker illustrated the various processes by lantern and kinematographic pictures.

King's College, London, Old Students' Association.—ENGINEERING FACULTY.—A luncheon will be held at the Holborn Restaurant, at 1.15 p.m. on Wednesday, October 27th, when the chair will be taken by Mr. C. H. Wordingham, C.B.E. Old students are requested to communicate with the Hon. Assistant Secretary, Mr. D. H. Kendon, King's College, W.C. 2.

Paisley Association of Electrical Engineers.—Mr. W. R. Bruce, of the Paisley District Tramways Co., will open the ensuing session with his presidential address on October 20th. Several interesting papers and visits have been arranged for the session, the first item being a visit to Messrs. Harland & Wolff's Govan shipbuilding yard.

Electrical Power Engineers' Association.—On Saturday last the Southern Division gave the second annual dinner to the members of the National Executive Council at the Holborn Restaurant. Mr. W. J. Jeffery presided, and there was a large attendance of members and ladies.

After the toast of "The King," Mr. A. L. Lunn, past-president, proposed "The Ladies," urging them to see that their husbands attended the meetings of the Association. He pointed out that before the advent of the E.P.E.A., they had a poor time; the conditions were now much better, and would go on improving, but they must have no waverers—firm support was the only means of securing better terms. Mr. A. H. Allen, proposing "The E.P.E.A.," reminded them that internal friction crippled the efforts of its predecessor, the A.E.S.E.; the new Association, formed to secure representation on the Whitley Councils, had obtained a satisfactory alternative—the Joint Industrial Board—and its schedule of salaries was in course of adoption, while its efforts in the cause of peace had been successful in staving off the threatened disaster to London.

The event of the evening was the presentation to Mr. Lunn of a silver tea and coffee service, together with a gold bracelet for Mrs. Lunn, and silver knives and forks for Master Lunn. In introducing the presentation, the President, Mr. J. H. Parker, said that Mr. Lunn, as their first president, laid the foundations of the Association on a sound basis and welded the National Executive Council into a harmonious whole. Every town in the kingdom had

contributed with spontaneous enthusiasm to the presentation, which was a token of their admiration for the splendid work he had done for the Association during the past four years. Mr. J. F. Heslop followed, expressing his admiration for the past-president, and the magnificent progress which had been made in so short a time under his guidance, so that the Association was now invited to confer with the Board of Trade; Mr. Essex said the Association was started under great difficulties, but Mr. Lunn was a born leader; and Mr. Jeffery pointed out that to accept the office of first president of the first staff Trade Union required immense courage. Pressure had been brought to bear on senior officials in the S.W. area to leave the Association—let them bear in mind the example of Mr. Lunn two years ago, and have the pluck to stay in it to-day. Mr. Lunn, in reply, expressed difficulty in finding words suitable to convey to them his sincere thanks on behalf of his wife and child and himself.

After an interval, Mrs. Parker responded to the toast of "The Ladies," remarking that her husband had so much to say about the E.P.E.A., &c., nowadays that she could hardly get a word in edgeways; she hoped that more settled times were now before them, and believed that meetings such as that would bear good fruit.

The President, Mr. Parker, then responded to the toast of the E.P.E.A., in a speech of exceptional eloquence. After expressing gratitude to the electrical Press for its support when the Association was yet an unknown quantity, he eulogised the fighting qualities of the Executive Council and the Emergency Committee, which could always get out of a hot corner. They had recently faced a difficult situation; they had always endeavoured to avert strikes in the electricity supply industry, at great cost to the Association, and when the Electrical Trades Union chose the path of peace, for the first time in two years, they could not withhold their support from it. On the other hand, their members could not be expected to stop work at a moment's notice, and therefore they insisted on the E.T.U. giving seven days' notice; during that period they succeeded in inducing the disputants to make peace. As a result of their interviews with Sir Robert Horne, he had promised to help them to enforce their schedule of salaries. The Executive Council was able to hold the scales level in the electricity supply industry; the nation was reaping the fruit of unfair dealings in the past between masters and men—they should strive to maintain peace by enforcing fair play on both sides. The Executive Council was inspired by great ideals, and demanded a square deal; it was the only organisation that could compel peace in the industry.

During the evening an excellent musical programme was performed by Misses Ellen Collins, Lily Grahame, and Marie Fein, and Messrs. Will Pither and J. Purvis, accompanied by Mr. Stanley Chapple, almost every item being encored; the K.V.A. orchestra also rendered admirable service, the whole of the entertainment being provided by members and their lady friends.

Junior Institution of Engineers.—At the annual meeting of the North-Eastern Section of the Institution, Dr. W. M. Thornton, Professor of Electricity at Armstrong College, Newcastle, delivered his presidential address at that Institution on October 6th. His subject was "Science and the Future of Engineering." Prof. Thornton, having considered the forces of nature in their text-book order, with regard to mechanics, said the growth was bound up with the process of evolution; there were no new mechanical laws to be expected, and, therefore, they must look to the future of mechanical engineering for the development of new types of tools and appliances. They could, however, perhaps expect developments in water-power and the use of the tides, schemes for the use of which were being considered all round the British coast. The development of this was intimately connected with the developments of fuels. Under the head of sound there was at the present moment before the public a system of transmission of power by wave motion, which was really transmission by sound wave, if the claims of the inventors were correct; if not, it was hydraulics used in the same way as alternating currents were used in electricity. Discussing new sources of heat, the professor remarked that solar heat did not seem to be realisable directly for engineering purposes. The earth's underground heat, Sir Charles Parsons had suggested, might be tapped by means of immense bore-holes 12 miles deep. The suggestion was undoubtedly an engineering possibility, and it would be extremely interesting to see it carried out. The supply of heat from such a source was limited only by the low conductivity of rocks at high temperatures. On the subject of electricity and magnetism, the speaker said it was now known that all matter was made up of small electrical charges called electrons, and the problem, at present inconceivable, was to tap that source of electricity without going through the inefficient process of conversion into heat. There had been attempts to utilise the energy of coal to obtain electricity, and the science of electro-chemistry was gradually indicating the possible lines of attack. If we could obtain electricity at high pressure from the energy of coal, oil, or alcohol without burning, an immense advance would be made. The problem of obtaining power from atomic matter had been before the scientific public for the last few years, but no lines of advance had yet opened out; a method as likely to be successful as any would, perhaps, be to tap the energy contained in the construction of the electrons themselves. If they considered them as permanent strain centres in the ether, nothing could be done, but if as was remotely possible electrons could be annihilated, the energy liberated would be enormous. For example, the electron was a strain centre like a knot, and when combined with an electron of opposite sign formed a closed system of kinks. It was just possible that, in the same way as one could cause a kink in india-rubber to straighten out flat by throwing it violently on the floor, one might be able to break up the electrical structure by violent collisions with a consequent liberation of energy. The amount of power realised would make up for the amount of power required to obtain it. That was the merest speculation; he thought, however, that it was much more likely that they would be able to tap the energy contained in atomic structure than in the electrons of which it was made, yet neither source was beyond the realm of possibility.

Birmingham and District Electric Club.—At the meeting of the Club, on October 9th, a paper was read by F. S. J. Pile, M.A., member, on "Thermo-Electric Currents as Applied to Pyrometry." It dealt with the early difficulties encountered both with the thermo-couples and with the indicating and recording instruments, and gave full descriptions of the most recent devices, dealing specially with the compensating arrangements at the cold junction of the couple, and with the latest contrivances for preventing zero creep in the micro-voltmeter. The lecturer was ably assisted by Mr. Stone, who is the inventor of many of the special appliances used in modern pyrometry. The lecture was illustrated by a full range of couples and indicating and recording instruments of the latest types, and was much enjoyed by a very appreciative audience.

Manchester Association of Engineers.—The inaugural meeting of the session took place on Saturday last. In the afternoon upwards of 300 members had the opportunity of viewing the extensive works of Messrs. Sir W. G. Armstrong, Whitworth and Co., Ltd., at Openshaw. The evening meeting was held at the Memorial Hall, to which place the Association has moved in view of the extraordinary increase in membership. The chair was occupied by the President, Mr. Henry Pilling, M.B.E. The "Constantine" Gold Medal was presented to Mr. Pilling by Mr. Harold F. Massey, ex-President, for his able paper on "Uniflow Steam Engines." The "Butterworth" Medal was awarded to Mr. George E. Windeler for his contributions to discussions during the past session. Subsequently the President delivered his inaugural address, the main theme of which was the desirability of the Association paying more systematic attention to the rising young men in the engineering industry of Manchester, with the hope that it would make greater efforts in this direction than in the past.

Glasgow Corporation Electricity Department Engineering Society.—The Society commenced its winter session on the 4th inst., at the head offices, Waterloo Street. The Society is entering on the fourth year of its activities, and has now a membership of over 400. Mr. R. B. Mitchell, engineer and manager of the department, in delivering his presidential address, dealt with the present outlook in electrical engineering, with special reference to electricity supply undertakings. After mentioning the lessons gained from the war in the way of standardisation of plant and apparatus, he referred to the question of industrial fatigue and schemes for the welfare of employés. Dealing with electrically-propelled commercial vehicles, he said that the present high price for petrol made this a unique opportunity for the electrical engineer developing the use of such vehicles, and pointed out that electric passenger-carrying vehicles had not been used to any extent in this country, although they were widely used in America and on the Continent. Mr. Mitchell said that the new system evolved by a Rumanian, M. Constantinesou, for the transmission of mechanical energy by vibrations was destined to play a great part in the development of industry, and the applications would in some cases supplant transmission of energy by electricity. He thought that while this new system might not benefit the manufacturers of electric motors, it would ultimately be of benefit to electric supply undertakings.

Institution of Electrical Engineers (East Midland Sub-Centre).—The opening meeting of the session, 1920-21, will be held at the Technical College, Loughborough, on Tuesday, October 19th, at 6.45 p.m., when an address will be delivered by the chairman, Mr. F. S. Grogan.

Edinburgh Electrical Society.—On Friday last, Mr. Stark delivered a lecture on "The Electric Equipment of a Modern Battleship," to a large attendance of the members. Special attention was given to the electrical gear for fire control and navigation purposes.

Mr. Macintosh, the chairman, expressed satisfaction with the considerable number of new members who were coming forward to join the society, and announced that the next meeting would take place at the offices of "The Scotsman" on Thursday, the 21st inst. at 7.30 p.m.

Warrington Electrical Society.—This Society held its first regular meeting of the session on the 8th inst. Mr. F. V. L. Mathias, Corporation electrical engineer, was in the chair, and addressed a large audience. Mr. Evans, of St. Helens Cable and Rubber Co., Ltd., and Mr. Smith, local chairman of the E.T.U., moved and seconded a vote of thanks to the chairman. The rest of the evening was devoted to impromptu discussions by Mr. Robertson on the fixing of switch and ceiling-rose blocks, and by Mr. Senior on the correct way to fix electrical tubing. Meetings will take place on the second and fourth Fridays in each month, in the Technical Schools.

The Faraday Society and the Physical Society of London.—For the convenience of those attending the general discussion on "Colloids," on October 25th, it has been arranged to hold a dinner at the Hotel Victoria, Northumberland Avenue, at 6.30 p.m. sharp, between the afternoon and evening sessions. The price per head will be 12s., payment to be made at the dinner. As the arrangements only hold good if a sufficient response is received from those attending the meeting, the secretary, Mr. F. S. Spiers, will be glad to know, not later than October 18th, whether he may reserve places for them.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

At a meeting of the Stockton-on-Tees Town Council on 5th inst., it was reported that a letter had been received from the hon. secretary to the Associated Municipal Electrical Engineers with reference to the salary of the Council's chief electrical engineer, MR. J. J. SMITH, and that it had been decided not to accede to the application, but to recommend to the full Council in committee that the salary of the engineer should be increased to £600 per annum, such sum not to include the existing bonuses, the bonus under consideration (whether granted or not) and all future bonuses.

MAJOR H. J. DE COURCY MOORE, who is one of the candidates for the City of London Aldermanic vacancy, and will seek election to the office of Sheriff next year, is a Fellow of the Institute of Chartered Accountants, and chairman of Messrs. T. Clarke and Co., Ltd., electrical contractors.

Canterbury Town Council has increased the salary of the chief electrical engineer from £575 to £640 per annum, as from April 1st last.

MR. JOHN O. WILLIAMS and MR. G. B. JACKSON have been appointed in a temporary capacity by the Liverpool Electrical Power and Lighting Committee as assistant inspectors of installations.

MR. MEADE, who has consented to nomination as Mayor of Stafford, though formerly in the electrical industry, is now engaged in motor production, &c. He took his electrical degree at Finsbury College, was a pupil of Messrs. R. A. Scott & Co., and subsequently he was associated with the Planet Electrical Engineering Co., and the British Aluminium Co., whose electrical equipment at their mills at Stoke-on-Trent he supervised. Later he was, for 12 years, chief engineer of the Stafford Corporation Electricity Works.

The Morley Town Council has advanced the salaries of leading officials, including that of the borough electrical engineer, from £438 to £500 per year.

MR. H. BRAMALD, electrician at the Crigglestone Colliery, Yorkshire, for the past eight years, has been presented by his colleagues of the colliery electrical department with a fountain pen and a set of brushes, on his leaving to take up a position at Sheffield.

We understand that MR. G. WATSON, M.Inst.C.E., M.I.Mech.E., has now ceased to represent the New Destructor Co., Ltd., and that he is carrying on his practice as a civil and mechanical engineer at the same address as before, viz., Walter House, Bedford Street, Strand, London, W.C. 2. His large experience in connection with refuse disposal, and also furnaces and boilers for steam raising from low-grade fuel will, therefore, still be available, either to contractors for, or users of, such plant.

St. Annes Council has appointed MR. H. W. LAING as the manager of Blackpool, St. Annes, and Lytham tramway, as from November 1st, when the line becomes the property of the Council. Mr. Laing is the present manager under the private company.

Wolverhampton Town Council has decided to retain the services of MR. DUDGEON, line superintendent of the Birmingham Corporation tramways, to assist the tramway manager and engineer in carrying into effect the conversion from the Lorain surface contact to the overhead tramway system, at a fee of £210, plus out-of pocket expenses.

The Times states that MR. L. G. KILLBY, superintendent of the Department of Technology, City and Guilds of London Institute, has been appointed secretary to the Empire Cotton-Growing Committee.

MR. R. G. RAWKINS, manager and secretary of the Notting Hill Electric Lighting Co., Ltd., has been nominated by his colleagues as Mayor of Windsor for the coming year, and it is expected that the nomination will receive the unanimous support of the newly-elected members on November 9th. Councillor Rawkins has been a valued member of the Council for 11 years, and for some time past has acted as chairman of the Finance Committee.

Obituary.—MR. GEORGE TANGYE.—We regret to record the death which occurred on October 8th, at the age of 85 years, of Mr. George Tangye. He was one of the several brothers who launched the celebrated business at Birmingham which still bears their name. Mr. George Tangye was chiefly identified with the business side of the concern.

MR. HENRY STEEL.—We regret to record the sudden death of Mr. Henry Steel, chairman of Steel, Peech & Tozer, Ltd., of Rotherham, and of the United Steel Companies, Ltd.

MR. A. CAMERON.—The death took place at 78, Grange Loon, Edinburgh, on October 5th, of Mr. Alexander Cameron, late superintendent, Eastern Extension Telegraph Co., Penang.

MR. G. W. GILES.—The death occurred at Fribourg (Switzerland) on August 14th, of George Washington Giles, who had just completed his 54th year. He was a director of the Société Générale des Condensateurs Electriques at Fribourg. By his inventions and studies he did much to improve the protection of networks from over voltage, the electric valve which bears his name being in common use for the protection of alternators and underground networks.

SIR JOHN MCLAREN.—On October 12th Sir John McLaren, head of the firm of Messrs. J. & H. McLaren, engineers, of Hunslet, died at the age of 70 years.

Wills.—The late PROF. JOHN PERRY, F.R.S., left £10,343.

NEW COMPANIES REGISTERED.

B. M. C., Ltd. (170,661).—Private company. Registered October 6th. Capital, £1,000 in £1 shares. To carry on the business of electricians, motor and mechanical engineers, manufacturers and workers of and dealers in electricity, &c. The subscribers (each with 250 shares) are: R. O. Bird, 32 Nicholson Road, Addiscombe, Croydon, Surrey, manufacturer; P. W. J. Collin, 37, Farnley Road, South Norwood, S.E.25, import agent. First directors not named. Registered office: Arcadia Works, Grant Road, Croydon.

Fryer & Hartley, Ltd. (170,681).—Private company. Registered October 7th. Capital, £8,000 in £1 shares. To acquire the business carried on by T. Fryer and T. Hartley at Slack Street, Rochdale, as "Fryer & Hartley," and to carry on the business of electricians, mechanical engineers and manufacturers, tool makers, &c. The first directors are: T. Fryer, 80, Molyneux Street, Rochdale; T. Hartley, 5, Minerva Terrace, Littleborough; P. Ogden, Hillcrest, Spotland, Rochdale; L. Wolstenholme, 20, Meanwood Brow, Rooley Moor Road, Rochdale. Secretary: P. Ogden. Registered office: Slack Street, Rochdale.

Electric Car and Accessories Co., Ltd. (170,569).—Private company. Registered October 1st. Capital, £2,000 in £1 shares. To carry on the business of manufacturers of and dealers in electrical motor vehicles, trucks, tractors and locomotives, electricians, electric motor, mechanical and general engineers, manufacturers of electrical accessories, &c. The subscribers (each with one share) are: C. Macaskie, 24a, Castletown Road, W.14, electrical engineer; L. D. Francois, 118, Ritherdon Road, Balham, S.W.17, electrical engineer. C. Macaskie is permanent governing director and chairman. Solicitor: J. E. M. Crowther, 23, Abingdon Street, Westminster.

Craven and District Private Telephone and Electric Co., Ltd. (170,536).—Private company. Registered September 30th. Capital, £4,000 in £1 shares. To take over from J. Banks and J. H. Oxley the business carried on at Keighley Road, Skipton, Yorks., as the "Craven and District Private Telephone and Electric Co." The first directors are: J. Banks, 14, Romille Street, Skipton; J. H. Oxley, 37, Bright Street, Skipton (both permanent, subject to holding £500 shares). Secretary: F. W. Beard. Registered office: Keighley Road, Skipton, Yorks.

Birmingham and Staffordshire Electrical Co., Ltd. (170,662).—Private company. Registered October 6th. Capital, £3,000 in £1 shares (1,000 founders). To carry on the business of electricians, mechanical engineers, manufacturers and workers of and dealers in electricity, &c. The subscribers (each with one ordinary share) are: A. E. Legg, 4, Dogfield Street, Cardiff, cashier; C. H. Moore, 31, Denton Road, Cardiff, clerk. The first directors are to be appointed by the subscribers. Registered office: Post Office Buildings, Samuel Street, Bloxwich, Staffs.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Everett, Edgcumbe & Co., Ltd.—Return dated July 5th, 1920. Capital, £45,000 in £1 shares (5,000 6 per cent. cumulative preference, 39,997 ordinary, and 3 "A"). 3,300 preference, 26,683 ordinary, and 3 "A" shares taken up. £12,470 paid. £17,516 paid. Mortgages and charges, nil.

W. J. Jenkins & Co., Ltd.—Debenture dated September 15th, 1920, to secure all moneys due or to become due from company to National Provincial and Union Bank of England, Ltd., charged on company's undertaking and property, present and future, including uncalled capital.

Lester & Browne (London), Ltd.—Particulars of £500 debentures authorised September 20th, 1920, present issue £300, charged on the company's undertaking and property, present and future, including uncalled capital.

Ingleby & Co., Ltd.—Particulars of £12,000 debentures authorised July 22nd, 1920, whole amount issued: charged on the company's undertaking and property, present and future, including uncalled capital. Satisfaction in full on September 20th, 1920, of debentures dated September 13th, 1911, securing £2,000.

Dawlish Electric Light and Power Co., Ltd.—Second mortgage debenture dated September 24th, 1920, to secure £2,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: J. M. Houghton, 3, The Strand, Dawlish, and W. H. Gillett, 39, Threadneedle Street, E.C.

Borland Hagedorn & Co., Ltd.—F. J. Stafford, of 75a, Belsize Park Gardens, Hampstead, N.W., ceased to act as receiver or manager on February 2nd, 1920.

Bar Meter Co., Ltd. (99,327).—Return dated July 23rd, 1920. Capital, £20,000 in £1 shares (12,000 preference and 8,000 ordinary). 10,683 preference and 8,000 ordinary taken up. £8,118 paid (being £1 per share on 423 and 15s. per share on 10,260 shares, all preferred). £8,000 considered as paid on 8,000 ordinary shares. Mortgages and charges, nil.

Wardle Engineering Co., Ltd. (102,714).—Return dated August 31st, 1920 (filed September 6th). Capital, £7,000 in £1 shares (5,000 ordinary and 2,000 preference). 4,320 ordinary and 2,000 preference shares taken up. £6,120 paid. £200 considered as paid. Mortgages and charges, nil.

United Electric Car Co., Ltd.—Return dated March 18th, 1920. Capital, £300,000 in £1 shares (150,000 ordinary and 150,000 preference). 150,000 ordinary and 100,000 preference taken up. £250,000 paid. Mortgages and charges, nil.

Electrical Appliances (Blackpool), Ltd.—Mortgage dated September 17th, 1920, to secure £2,450: charged on 5, Bloomfield Road, Blackpool. Holders: Mrs. E. Chadwick, The Gables, Park Road, Thornton-le-Fylde; and Mrs. M. Sharples, "The Uplands," Hardhorn, Poulton-le-Fylde.

Telephone Manufacturing Co., Ltd.—Satisfaction in full on August 24th, 1920, of debentures dated October 8th, 1920, securing £20,000.

Fors Accumulator Foreign Patents, Ltd. (108,151).—Return dated January 11th (filed September 8th, 1920). Capital, £3,000 in £1 shares (952 preference and 2,048 ordinary). 584 preference and 2,048 ordinary shares taken up. £132 paid. £2,500 considered as paid. Mortgages and charges, £125.

Christy Brothers & Co., Ltd. (90,039).—Return dated November 21st, 1919 (filed August 3rd, 1920). Capital, £22,000 in £1 shares (14,000 ordinary, 8,000 deferred, and 5,000 7 per cent. cumulative preference). 10,537 ordinary, 3,000 deferred, and 250 preference shares taken up. £4,687 paid. £9,100 considered as paid. Mortgages and charges, £4,600.

Cecil Hodges & Co., Ltd.—Satisfaction to the extent of £250 on March 20th and £50 on May 10th, 1920, of mortgage debentures dated March 1st, 1910, securing £500.

CITY NOTES.

Auckland Electric Tramways Co., Ltd.

The twenty-third ordinary general meeting was held at the Electrical Federation Offices, Kingsway, on October 6th, the Chairman, Mr. C. G. Tegetmeier, presiding. The directors' report and statement of accounts (briefly noticed in the Electrical Review of October 8th, p. 471) were unanimously adopted. The Chairman, referring to the purchase of the Auckland Corporation tramway undertaking, said it was a matter for congratulation on both sides that a transaction of such a magnitude had been carried through successfully. There was a desire among some of the New Zealand shareholders that the Corporation Debentures should be distributed among the shareholders, but there were many objections to this course. Every favourable opportunity of disposing of the Corporation Debentures in New Zealand was being taken, and the proceeds were being invested on this side. In order to effect sales in a competitive market it had been found necessary to reduce the price of the debentures to £90 per cent., but £75,300 had been disposed of at an average price of £92 per cent. The policy that was being pursued by the board was, in effect, the liquidation of the company at the time and in the manner likely to produce the best results. The position shown by the accounts indicated that in the continuance of this policy the present dividend of 6¼ per cent. on ordinary shares could be maintained, and that in view of all circumstances the present time did not present a favourable opportunity of winding up the company. Messrs. Horton and Leys as New Zealand shareholders expressed their approval of the company's policy with regard to the realisation of the Auckland Corporation debentures.

Direct United States Cable Co., Ltd.

The accounts for the year ended March, 1920, were delayed pending the conclusion of negotiations referred to below. The total income was £55,292, but in view of the heavy expense of maintaining the cables and the necessity of providing for the costs of the action against the Western Union Telegraph Co., the directors are unable to recommend the payment of any dividend for the period covered by the accounts. They have, however, declared a dividend at the rate of 4 per cent. per anum for the six months ending September 30th, 1920. The cost of maintaining the cables for the year amounted to £89,210, out of which £62,590 represented the cost of the "Faraday" expedition to repair the main cable in May, June and July, 1919. In recognition of services rendered as manager and secretary, the directors have elected Mr. W. Miles, O.B.E., to a seat on the board. In a circular accompanying the report the directors report that the negotiations have been brought to a successful conclusion.

When the High Court gave a decision adverse to this company in its action against the Western Union Co. an appeal was at once entered, but this was stayed by mutual consent with a view to some arrangement being arrived at between the two companies for a continuance of the lease. The directors regret that these efforts were not successful, the ultimate proposals of the Western Union Co. being of such a nature as to preclude the board from recommending their consideration by the shareholders.

An offer has, however, been received from H.M. Government for the purchase of the company's cable as laid, its properties, equipment and stock cable, which offer will be submitted at the meeting on October 19th.

The directors recommend the shareholders to sanction the acceptance of this offer, which they estimate will, after discharging the company's liabilities, permit of a payment being eventually made to the shareholders of at least £6 per share.

The board believe that the income to be derived from the existing securities and the interest upon the purchase consideration to be received from the Government will permit of the payment of a dividend of about 4 per cent. per annum until the company is finally dissolved.

The directors desire to express their sympathy with the shareholders in the difficult conditions they have been called upon to face during the past eighteen months, and to congratulate them upon what they feel must be regarded as a satisfactory termination of a trying period of suspense.

French Companies.

The *Société des Porcelaines et Appareillages Electriques Grammont* reports gross profits of 2,089,000 fr. for 1919-20, as compared with 1,508,000 fr. in the preceding year, and net profits of 430,000 fr. and 267,000 fr. in the two years respectively. It is intended to pay a dividend at the rate of 10 fr. per share, as against 8.50 fr. in 1918-19. At a recent extraordinary meeting it was decided to increase the share capital by 2,500,000 fr. so as to provide for the development of business resulting from the acquisition of the Radiquet works for the production of porcelain for electrical purposes.

The *Société La Maison Breguet*, reporting on the year 1919-20, states that although the orders were abundant, the turnover was materially reduced owing to difficulties in connection with transport, the scarcity of coal and of other raw materials, strikes and increases in wages. Nevertheless, conditions were now tending in the direction of becoming normal. Large orders had been received for the reconstruction of the devastated districts, but the provisional workshops erected at Paris would be unable to meet the requirements for electrical plant. As a consequence the directors had concentrated their efforts on the reconstruction of the works at Douai. The installations at the works of Deville-les-Rouen were now completed, and the works was able to undertake manufacturing. On the other hand, arrangements had been concluded which would provide for the Paris shops regular orders intended to replace those for electrical plant when the production of the latter had been transferred to Douai. The net profits earned in 1919-20 amount to 1,605,000 fr., as compared with 2,048,000 fr. in the preceding year, and a dividend at the rate of 50 fr. per share has been declared as in 1918-19.

The new issue having been fully subscribed, the capital of this company is now 8,000,000 fr.—that is, exactly doubled.

Appareillage Electrique Grivolas.—The accounts of this company for the working year 1919-20 show a net profit of 982,285 fr., against 754,416 fr. in 1918-19. It is proposed to pay a dividend of 10 fr. on each fully paid up share, which is the same as the foregoing year's dividend. In addition, from the sum of 162,500 fr., being the premium realised on the new issue of shares, it has been decided to set apart 106,940 fr. as dividend on the 2,138,800 fr. new capital lately raised.

Société Nantaise d'Eclairage et de Force par l'Electricité.—The shareholders have authorised the management to create 100,000 new shares, the issue to be made in one or more operations, as deemed suitable. The capital will thus be raised to 40,000,000 fr.

German Companies.

The *Wolfram Lampen A.G., of Augsburg*, reports that the deficit of 261,000 marks in 1918-19 increased to 506,000 marks in 1919-20. The factory is still in operation, although the lease expired at the end of 1919.

The directors of the *Kabelwerk Rheydt A.G., of Rheydt*, recommend a dividend for 1919-20 at the rate of 30 per cent. and a bonus of 100 marks per share, as contrasted with a rate of 30 per cent. in the preceding year.

The *Wothan Werke A.G., of Leipsig*, proposes to pay a dividend at the rate of 15 per cent. and a bonus of 250 marks per share for 1919-20, as compared with 15 per cent. and 150 marks respectively in the previous year. The share capital is to be increased from 2,600,000 to 6,600,000 marks.

The *Brandenburg Carbid und Elektrisitäts Werke, A.G., of Berlin*, after writing off 800,000 marks for depreciation in 1919-20 as against 200,000 marks in the previous year, reports net profits of 325,000 marks as compared with 322,000 marks in 1918-19. It is proposed to pay a dividend at the rate of 7 per cent., as in the preceding year. The report states that no material change took place in the carbide branch, and the production had to be delivered to the State distributing department. It was not possible for the Steinbusch works to resume the manufacture of carbide, as contracts for the supply of energy had first to be satisfied. The Muhlthal works passed into the possession of Poland.

Electrolytic Zinc Co. of Australasia, Ltd.—Shareholders in Amalgamated Zinc (De Bavays), the Zinc Corporation, Broken Hill South, the Mount Read and Rosebery Mines, North Broken Hill, Tasmanian Copper Company and the Mount Lyell Mining and Railway Company are invited to apply for shares in proportion to their holdings in the Electrolytic Zinc Company of Australasia, Ltd., on terms of the prospectus of that company, copies of which have been posted to the shareholders concerned. The issue consists of 1,100,000 cumulative participating preference shares of £1 each, such shares being preferential as to capital and as to dividends to the extent of 8 per cent. per annum cumulative, in addition to which they will rank, *pari passu*, with the ordinary shares in any further dividend distribution after 8 per cent. per annum has been paid on such ordinary shares. The issue is being made mainly in order to provide funds for the completion of the company's works at Risdon, Tasmania.—*Financier.*

Stothert & Pitt, Ltd.—Mr. Walter Pitt, M.Inst.C.E., presiding at the annual general meeting at Bath on September 30th, announced a final dividend of 7½ per cent., making a total of 12½ per cent. for the year, free of tax, being similar to the previous year's dividend. The Chairman stated that there was a large number of orders in hand, and indications of an early revival of harbour and port construction in all parts of the world. The whole of the share capital of the old firm of Torrance & Sons, Ltd., recently liquidated and reconstructed, was held by Stothert & Pitt, Ltd., and the boards of directors of the two companies were identical. The Bitton works were full of orders and the results very satisfactory. The retiring directors were re-elected, as also were Messrs. Tribe, Clarke, Painter, Darton & Co., the auditors.

Oldham, Ashton & Hyde Tramways Co., Ltd.—The arbitration respecting the decision of local authorities to purchase the undertaking has resulted in the purchase of the same for £142,174. The directors state that there will be a surplus available for both classes of shareholders after repayment of the capital.—*Financial Times.*

Oriental Telephone & Electric Co., Ltd.—Interim dividends of 3 per cent. on the 6 per cent. cumulative preference shares, less tax, and of 4 per cent. on the ordinary shares, free of tax.

Stock Exchange Notices.—Application has been made to the Committee to appoint special settling days in the following:—

Para Telephone Co., Ltd.—60,000 Ordinary shares of £1 each, fully paid (Nos. 1 to 60,000).

The Committee has been asked to allow the following to be officially quoted:—

Indian Electric Supply & Traction Co., Ltd.— 120,000 7 per cent. non-cumulative (convertible) preference shares of £1 each, fully paid (Nos. 1 to 120,000).

Montreal Light, Heat & Power Consolidated.—643,719 shares of 100 dols. each, in lieu of the shares of the Montreal Light, Heat & Power Co.

Parsons Marine Steam Turbine Co., Ltd.—Balance dividend of 15 per cent. recommended, making 25 per cent., tax free; £21,096 to be carried forward. Work has been considerably delayed owing to the great difficulty in obtaining deliveries of castings, due to the late moulders' strike.

Electric Supply Corporation, Ltd.—The gross earnings for 1919 amounted to £60,085, an increase of £8,707 upon the previous year. The sum taken into net revenue account amounts to £13,519. After paying interest upon debenture stock and actual cost of year's repairs and renewals, there is, including the balance brought forward, a surplus of £3,621. The directors propose to place £3,000 to reserve fund and to carry forward £621.—*Financial Times.*

Fellows Magneto Co., Ltd.—Interim dividend at the rate of 25 per cent. per annum, less tax, on the ordinary shares for half-year ended June 30th, 1920.

STOCKS AND SHARES.

TUESDAY EVENING.

THE uncertainty produced in business circles by the coal trouble is making itself evident amongst a number of industrial shares. People are afraid to launch out, however mildly, and cancellation of contracts has become common in many trades. Manufacturers, wholesale houses, and retailers are all beset by the same conditions. Men say frankly that they cannot tell how they stand, in view of the outlook. Industrial shares are therefore disposed to weaken. New issues continue to make their appearance, and so tempting are the terms offered on apparently good security that existing stocks and shares are naturally left on one side by the investor attracted by the later comers.

British Aluminium ordinary have gone back to a pound, and Edisons are about the same price, though nominally 20s. 6d. General Electric ordinary have shed 1s. and Siemens 6d., while in the prior-charge stocks, Edison 5 per cent. debenture is 2 down at 76½, stock having changed hands at 75. English Electrics at 18s. 6d. and the preference 15s., business being recorded this week at 18s. and 14s. 10½d. respectively. Vickers and Armstrongs are both about 22s. 3d. The only improvement in this group is another 1/16 rise in Callender's.

Shareholders in the Direct United States Cable Co. have this week received a pleasant surprise in the official intimation that an offer for the whole undertaking—apart from the reserve fund—has been received from the Government. The present quotation is 5½-6, although the market estimates work out the offer as being worth from 6½ to 6¾. Shares changed hands on Monday at 6. The first impression in the Stock Exchange is that the offer is a good one, and that shareholders should not fail to take advantage of it. For the price to remain below 6 is taken as evidence of willingness to secure their profits by people who bought more cheaply.

Cable shares otherwise are marked by no particular feature. Cuba Submarines are lower at 7. Marconis have gone back to 2¾ for want of interest in speculative shares. Globe preference recovered to 8¼.

Five points rise has lifted the income bonds of the Underground Electric Railways to 71¼. The £10 shares have gone up 10s. to 2¾, and the shilling shares are 1s. higher at 7s. 6d. Without a doubt, the advance is due to realisation of the difference to the companies which the fare-raising will mean, as pointed out here many times. Districts have risen to 19½; on the eve of war they stood at 21¼. Metropolitan Consolidated is unchanged at 21½. In caustic explanation of "Mets." being only 2 higher than Districts, a Stock Exchange cynic observed that the latter, having received no dividend for 38 years, ought really to stand above the steady dividend-paying Metropolitan stock. London and Suburban preference at 3s. 6d. are better, and a little business has been done this week in London United Tramways 4 per cent. debenture stock on the basis of 33½. London General Omnibus 4½ per cent. first debenture stock is about 66, and the company's 5 per cent. cumulative income debenture stock changed hands on Monday at 56½. The latter does not look dear, although the name of the security—cumulative income debenture—might austerely be described as a contradiction in terms. London Electric 4 per cent. preference has advanced to 46.

The Lancashire Electric Power Co. recently asked a loan of £700,000 from the Manchester Corporation for certain extension works, and the proposal was at first refused. On second thoughts, however, the Finance Committee of Manchester has agreed to the scheme, being urged thereto by the request of the Manchester Corporation that the matter should be reconsidered. The reasons for this change of front make interesting reading in the report issued by the Finance Committee. Evidently a weighty point is the fact that, in agreeing to the company's request, Manchester will be keeping its place as the chief authority in the Government's scheme for South-East Lancashire.

Several electricity supply shares are harder. Rises of ½ have been secured by Chelseas, South Londons, and Metropolitans. On the other hand, South Metropolitan 7 per cent. preference have given way to 16s. 3d., with business marked as low as 15s. The earlier voting of the miners does not encourage the idea that the men are eager to prove their readiness to increase the output of coal in return for higher wages. This consideration acts as a dead-weight upon the markets in iron, coal, and allied shares. The rubber market is flat in consequence of financial difficulties that have overtaken certain houses in Amsterdam known to be liberally stocked with raw rubber. Indeed, the troubles attendant upon gambling all round in such commodities as rubber, oil, and sugar are having a decidedly unfavourable influence over financial engagements far removed from the immediate causes of the slump that is shaking the Stock Exchange markets.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1918.	Dividend 1919.	Price Oct. 15, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	8	12	8½	—	£9 13 6
Charing Cross Ordinary	4	7	8½	—	10 15 6
do. do. do. 4½ Pref.	4½	4½	9½	—	8 8 8
Chelsea	5	4	7½	+½	7 15 6
City of London	6	10	14	—	8 17 10
do. do. 6 per cent. Pref.	6	6	17/6	—	6 17 3
County of London	7	8	7½	—	10 17 6
do do. 6 per cent. Pref.	6	6	8½	—	7 7 8
Kensington Ordinary	6	7	8½	—	9 0 6
London Electric	Nil	2½	11	—	6 8 6
do. do. 6 per cent. Pref.	6	6	8	—	15 0 0
Metropolitan	5	6	9½	+ ½	10 8 8
do. 4½ per cent. Pref.	4½	4½	9-8	—	8 0 0
St. James' and Pall Mall	10	13	6½	—	9 1 2
South London	5	6	9½	+ ½	9 12 0
South Metropolitan Pref.	7	7	16/3	- 9d.	8 12 8
Westminster Ordinary	8	10	8	—	10 0 0
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	7½	—	† 14 13
do. Def.	22/6	1½	17½	—	8 18 10
Chile Telephone	5	5	5½	—	*5 9 1
Cuba Sub. Ord.	7	7	7	— ½	*10 0 0
Eastern Extension	8	10	15	—	*8 13 4
Eastern Tel. Ord.	8	10	14½	—	*8 14 4
Globe Tel. and T. Ord.	8	10	14½	—	*8 18 0
do. do. Pref.	6	6	8¼	+ ¼	7 5 5
Great Northern Tel.	22	22	30	—	11 0 0
Indo-European	13	10	10	—	8 6 8
Marconi	25	25	2½	— ¼	9 1 10
Oriental Telephone Ord.	10	12	2⅝	—	*4 18 4
United R. Plate Tel.	8	8	6½	—	*6 8 0
West India and Panama	1/6	Nil	½	—	Nil
Western Telegraph	5	10	14½xd	—	*6 16 4
HOME RAILS.					
Central London Ord. Assented	4	4	43½	—	9 4 0
Metropolitan	1	1½	21½	—	6 16 9
do. Districts	Nil	Nil	19½	+1	Nil
Underground Electric Ordinary	Nil	Nil	9½	+ ½	Nil
do. do. "A"	Nil	Nil	7/6	+1/-	Nil
do. do. Income	3	4	71½	+ 5	—
FOREIGN TRAMS, &c.					
Anglo-Arg. Trams First Pref.	Nil	6½	8½	—	8 9 2
do. do. 2nd Pref.	Nil	Nil	5½	—	Nil
do. do. 5 Deb.	5	5	57½	—	8 13 10
Brazil Tractions	Nil	Nil	46½	+ ½	Nil
Bombay Electric Pref.	6	6	13½	—	4 16 0
British Columbia Elec. Ry. Pfce.	5	5	54	—	9 5 2
do. do. Preferred	5½	5	80½	—	*6 7 8
do. do. Deferred	Nil	3	50½	—	*6 7 8
do. do. Deb.	6½	6½	85½	—	7 19 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	44	—	Nil
do. 6 per cent. Bonds	Nil	Nil	54	—	Nil
Mexican Light Common	Nil	Nil	15	+1	Nil
do. Pref.	Nil	Nil	27½	—	Nil
do. 1st Bonds	Nil	Nil	58	- 3	Nil
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	8½	—	*8 0 0
British Aluminium Ord.	10	10	1	—	10 0 0
British Insulated Ord.	12½	15	1½xd	—	8 17 10
Callenders	25	15	1⅛	+ ⅛	10 3 8
,, 6½ Pref.	6½	6½	18/9	—	6 18 8
Castner-Kellner	20	17	8	—	8 13 4
Crompton Ord.	10	10	17/6	—	11 8 6
Edison-Swan, "A"	10	10	20/6	—	9 15 3
do. do. 5 per cent. Deb.	5	5	76½	- 2	6 10 9
Electric Construction	10	10	18/3	—	10 19 2
Gen. Elec. Pref.	6½	6½	18/6	—	7 0 3
do. Ord.	10	10	27/-	- 1/-	†7 8 3
Henley	25	15	13	—	5 4 8
do. 4½ Pref.	4½	4½	9½	—	7 4 8
India-Rubber	10	10	11½	—	*8 0 0
Met.-Vickers Pref.	—	6	2½	—	7 6 2
Siemens Ord.	12	10	24/6	—6d.	*6 3 4
Telegraph Con.	20	20	20	—	*6 0 0

* Dividends paid free of Income Tax.

SOME NOTES ON METERING DEVICES USED IN CONNECTION WITH TARIFFS PENALISING LOW POWER FACTOR.

By G. W. STUBBINGS.

(*Concluded from page* 453.)

The principle of the construction of an induction meter which will integrate the product of the voltage into the wattless component of the current is much simpler. Considering the fundamental equation of a single-phase meter,

$$T = k\,I\,V \sin(a - \phi),$$

if a be made equal to 0, then

$$T = k\,I\,V \sin \phi, \text{ neglecting the minus sign.}$$

All that is required, therefore, in order that a single-phase meter shall integrate the wattless component of the load, is that the pressure flux shall be in phase with the voltage producing it.

A three-phase meter similarly adjusted will also give a true integration of the wattless component of the power. To some this may appear self-evident; it is easily demonstrated in the following manner: The ordinary energy meter has a torque proportional to the sum of three such terms as the average value of $v \sin p\,t \times i \sin (p\,t - \phi)$,

or to $v_1 i_1 \cos \phi_1 + v_2 i_2 \cos \phi_2 + v_3 i_3 \cos \phi_3$.

Rotation of the voltage vectors through 90° will cause the meter to give the sum of three such terms as $v\,i \cos(\phi + 90°)$,

or $v_1 i_1 \sin \phi_1 + v_2 i_2 \sin \phi_2 + v_3 i_3 \sin \phi_3$,

and the adjustment of the pressure fluxes to phase coincidence with the voltages producing them, is plainly equivalent to a rotation of the voltage vectors through 90°.

It has already been stated that the maximum demand in K.V.A. is assumed to be the square root of the sum of the squares of the maximum demands indicated by the energy

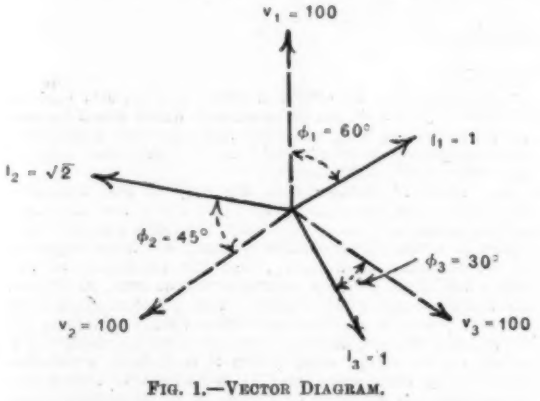

FIG. 1.—VECTOR DIAGRAM.

and wattless component meters. It is not difficult to show that this method is not strictly accurate for an unbalanced three-phase circuit.

The power in a three-phase circuit is given by—

$$P = i_1 v_1 \cos \phi_1 + i_2 v_2 \cos \phi_2 + i_3 v_3 \cos \phi_3.$$

The wattless component of the load by—

$$W = i_1 v_1 \sin \phi_1 + i_2 v_2 \sin \phi_2 + i_3 v_3 \sin \phi_3.$$

The volt-amperes in the circuit are—

$$i_1 v_1 + i_2 v_2 + i_3 v_3,$$

and it is apparent that this last expression is only equal to $\sqrt{(P^2 + W^2)}$ when the current is balanced, and—

$$\phi_1 = \phi_2 = \phi_3.$$

The power in a three-phase circuit, as given by the speed of the meter rotor, can be expressed as—

$$P = M \cos \phi'.$$

The speed of the wattless component meter will correspond to—

$$W = M \cos(\phi' - 90°) = M \sin \phi'.$$

Whence— $\sqrt{(P^2 + W^2)} = M$.

It therefore follows that the value of the K.V.A. obtained from the expression $\sqrt{(P^2 + W^2)}$ is not a true one, but is the value of the fictitious K.V.A. as indicated by the meter described above, with the important difference that the error due to $\cos \theta$ is eliminated, and a correct value of M is obtained at all power factors.

The circuit illustrated in fig. 1 will afford a numerical example of the results deduced above. A wattmeter connected in phases 2 and 3 will have a rotor speed corresponding to a value of the power given by—

$$P = v_{12}\, i_2 \cos(\phi_2 + 30°) + v_{13}\, i_3 \cos(\phi_3 - 30°)$$
$$= 100 \times \sqrt{3} \times \sqrt{2} \cos 75° + 100 \times \sqrt{3} \times 1 \times \cos 0$$
$$= 236.$$

The wattless component of the apparent power, as given by a wattless component meter similarly connected, will be—

$$100 \times \sqrt{3} \times \sqrt{2} \sin 75° + 100 \times \sqrt{3} \times 1 \times \sin 0$$
$$= 236.$$

The value of $\sqrt{(P^2 + W^2)} = 236\ \sqrt{2} = 334$, the value previously obtained for the fictitious K.V.A., the actual K.V.A. in the circuit being 342.

Wattless component integrating meters are now supplied by several firms, including Messrs. Landis & Gyr, Ferranti, Ltd., and Chamberlain & Hookham. In the three-phase meters supplied by the first of these firms, the requisite phase angle between the pressure flux and the voltage is obtained by connecting the pressure coils to different phases of the circuit from those used for an energy meter, so that the desired phase angle between the pressure flux and the voltage actually producing it is 30°. The accuracy of this method of compensation depends upon the equality of the phase voltages. In the three-phase meters supplied by Messrs. Ferranti, Ltd., a resistance is used in the pressure circuit, and the unavoidable lag of the pressure flux is corrected for by arranging for a corresponding lag in the flux produced by the current winding with respect to the current producing it. This method obviates the necessity of using an artificial voltage for exciting the pressure coil; and, in addition, enables meters of the wattless component type to be constructed for single-phase circuits.

A K.V.A. maximum-demand indicator is shortly to be placed on the market by the Aron Electricity Meter, Ltd., in which the average K.V.A. over a specified period is obtained by mechanically obtaining a value of $\sqrt{(P^2 + W^2)}$, where P and W are the average values of the power and wattless component respectively over the same period, as given by two meters of the energy and wattless component types. Such an instrument will give accurate readings, subject to the limitations above referred to, irrespective of power-factor variations. Particulars of this ingenious device can be obtained by consulting the Patent Specification (No. 130,485, 1919, Messrs. Jepson & Howarth).

The writer is much indebted to the makers of the meters referred to above for the information that they were so good as to place at his disposal.

An approximate method of obtaining the average power factor of a three-phase load, which is based on the assumption of that load being balanced, consists of the use of two single-phase meters for determining the energy consumption. With such a combination it is well known that, with a balanced load, the following relation is true—

$$\tan \phi = \sqrt{3}\,(W_1 - W_2)/(W_1 + W_2),$$

ϕ being the angle of lag or lead, and W_1 and W_2 being the readings of the two wattmeters. This method of determining an average power factor has been used to some extent in America, and although strictly applicable only to balanced circuits, will probably give a fairly approximate value for circuits supplying three-phase meters. A graphical method of obtaining $\cos \phi$, the average power factor,

from the values of W_1 and W_2, by the use of a special diagram, was given in a recent issue of the *Electrical World*. A useful approximation will, however, enable the power factor to be easily calculated from the ratio of the readings of the two watt-hour meters, and will dispense with the use of a special diagram. If the ratio W_1/W_2 be called x, the above equation can be put in the form—

$$\cos\phi = (x + 1)/2\sqrt{(x^2 - x + 1)}.$$

A portion of the graph of this equation is given in fig. 2, and it is at once apparent that the shape of the curve

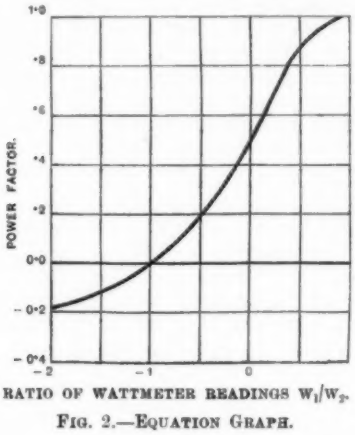

Fig. 2.—Equation Graph.

between the values $x = 0$ and $x = 1$, is very similar to that of a sine curve, and it is easily shown by differentiation that the slope of the curve in fig. 2 at the point $x = 0$, $\cos\phi = \frac{1}{2}$ is the same as that of the equivalent sine curve. A very close approximation to the value of $\cos\phi$ between the values of x is accordingly given by the equation $\cos\phi = \frac{1}{2}(1 + \sin 90x^\circ)$. The following table gives corresponding values of $\cos\phi$ calculated from the two expressions, and shows that between $\cos\phi = 0{\cdot}4$ and $\cos\phi = 1$, the difference between the two values does not much exceed 1 per cent. These limits cover the range of power factors actually met with, the accuracy of the approximation is comparable with that of the metering combination, and the formula is much better adapted for easy calculation than the correct one.

x	$\frac{1}{2}(1 + \sin 90x^\circ)$	$\frac{x+1}{2\sqrt{x^2 - x + 1}}$, $x = \frac{W_1}{W_2}$
0	0·5	0·5
0·2	0·655	0·655
0·4	0·794	0·803
0·6	0·905	0·912
0·8	0·975	0·982
1·0	1·0	1·0

It may be noted that for values of x between 0 and 0·25, the approximation $\sin\theta = \theta$ leads to the still simpler formula $\cos\phi = \frac{1}{2}\left(1 + \frac{\pi x}{2}\right)$. It is, of course, understood, that W_1 is the reading of the meter in the lagging phase.

This method of obtaining an average power factor will fail entirely if anything but an inconsiderable out-of-balance exists in the circuit. Returning, for instance, to the circuit shown in fig. 1, the value of the power factor as given by the above method, will depend upon the phases in which the meters are connected. The erroneous values so given, are:—For meters in lines 2 and 3, 0·77; meter in lines 1 and 2, 0·5; meters in lines 1 and 3, 0·58; the correct value being 0·71.

ELECTRICITY IN AGRICULTURE.

Devices for Tapping Overhead Distribution Mains, and Equipment for Electric Ploughing.

By R. E. NEALE.

For many years past we have taken every opportunity of laying stress upon the technical and economic possibilities of electricity in agriculture. Agriculture is admittedly the industry of primary importance to the life of every country, and it is the industry in which machinery and emciency have hitherto received totally inadequate consideration. Curiously enough it is the centralisation of other industries and their development on lines of engineering efficiency which have caused the exodus from country to town, robbing agriculture of its man power, and making more acute the need for similar methods in agriculture. Such was the position before the war, and the wastage of man power and the high wages caused by the latter have made it yet more necessary to save time and manual labour in agricultural operations. Whilst the need is more pressing, the opportunity is fortunately more favourable than ever before, for we have—in the development of super-power stations and overland transmission schemes—the means of furnishing a cheap supply of electrical energy in practically any part of the country.

Difficulties which have often been mentioned in the past still exist, but they are not insuperable. Given the main transmission line as a necessity, and a profitable investment for serving the bulk load of a city or an industrial district, there remains the problem of distributing energy for rural purposes in comparatively small quantities and over comparatively long distances. This difficulty appears greater the longer one contemplates it, particularly if one is obsessed by the idea that a clear profit must be shown from the first. Actually, we believe, the difficulty is one which will disappear progressively as the problem is tackled. The super-power station and national distribution scheme should certainly contemplate wholesale use of electricity for every possible purpose in rural districts—if this be not done it may be difficult, or impossible, later to give agricultural supply economically. The first developments of rural supply should then be made in the most favourable districts, and the educative value of and experience gained in these developments would undoubtedly lead to others. The question of capital outlay is by no means so serious as commonly supposed. Farmers individually or on a co-operative basis, are quite well able to contribute a reasonable proportion of the capital cost of distribution lines (just as they pay for roads), and they will do so readily enough when they have been convinced that it is a sound business proposition. Modern electrical safety devices and "automatic features" give a degree of protection which could be attained by no human agency, and they make possible a simplification and cheapening of construction which will reduce capital outlay without sacrificing safety.

A "natural" difficulty in the way of full utilisation of electricity in agriculture in this country is the small average size of farms, and, more especially, the small size and irregular shape of fields. Co-operative working has made rapid strides in all branches of industry, and the conditions of modern times will force it upon agriculturists as well, in the face of no matter what conservatism. The physical obstruction to efficient power ploughing and other machine-farming offered by hedges, ditches, or other barriers between adjoining small fields will be swept away when it is realised what waste is involved by their retention. It is possible to retain the line of demarcation between properties, without making it impossible to work either of them efficiently.

These introductory remarks outlining basic facts and principles are offered without apology, because now is undoubtedly the time for the agricultural applications of electricity to be exploited in earnest. The remainder of this article is devoted to two technical matters, viz., the safe and economical tapping of supply from high-voltage overhead lines, and the use of electrical energy for ploughing, this being the heaviest agricultural load. There is no difficulty in making a permanent tee-connection to an overhead line whatever the voltage thereon, but electric ploughing and other field operations involve the use of a tapping device, which can be manipulated safely by absolutely unskilled labour, as the only alternative to a complete network of low-voltage distribution cable, which is economically impracticable.

High-pressure Tappings for Farm Service.

The distribution of electrical energy for field services—of which ploughing is the heaviest duty, the demand being anything from 50 to 150 h.p.—is effected economically if high-pressure overhead lines be employed. A portable transformer is used, connection to the distribution line being made by a jockey or other connector, and service to the plough or other motor being given through an insulated trailing cable. The only point at which any difficulty is experienced in securing the requisite simplicity and safety is in the connection between

the overhead line and the transformer. Generally the transformer is mounted in a covered, wheeled truck, and the high-pressure connections are taken out through insulators mounted in the roof of the transformer cabin.

In the Siemens equipment heavily insulated cables are passed through the roof insulators, and terminate in bare metal rings. The latter are placed (by means of insulating poles), on contact hooks which are carried by insulators on a pole-bracket, and permanently connected to the overhead lines. This system necessitates the transformer wagon being placed quite close to a transmission post, and the cost of the connections, insulators, and brackets required on the poles is disproportionately heavy, compared with the service which they render.

A more economical and flexible system, devised by the Societe Générale Agricole, uses a special tapping pole which can be hooked directly on to the line at any desired point. Referring to fig. 1, a bamboo rod F is provided at its upper end with an insulated hook C, carrying a current-carrying spring R, which is connected through a fuse F to a wire passing through the centre of the bamboo rod. At the lower end of this wire is a terminal connected to the cable B leading to the transformer cabin. The spring R ensures rapid extinction of the arc formed when the fuse blows. In order to hook on to the line, a pole is inserted in the bell M, which is provided with an insulator I and mounted on the bamboo rod.

Both of the above methods have the advantage of being rapid in use, but they provide relatively poor contact with the

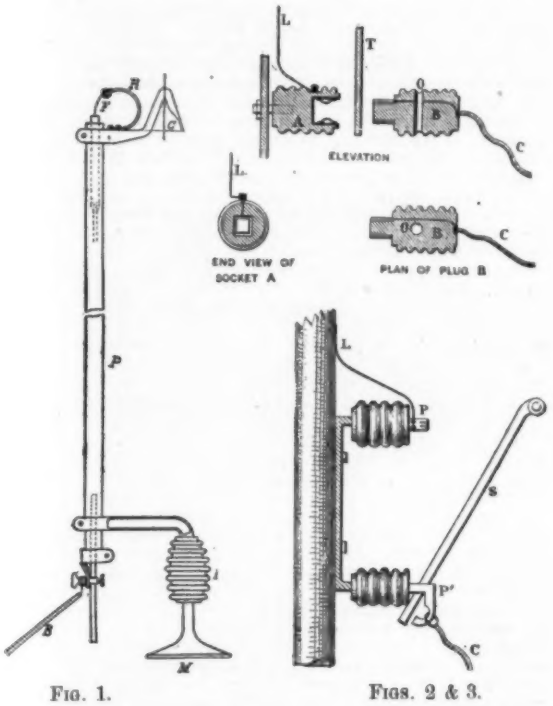

Fig. 1.

Figs. 2 & 3.

line, and introduce considerable risks both to the network and central station, and (which is more serious) to the actual user, especially in wet or misty weather, if the line voltage be, say, 10,000 volts or higher. Compared with the elaborate safeguards provided in central stations and sub-stations—which safeguards do not eliminate fatal accidents even amongst skilled attendants—the primitive simplicity of jockey connections which have been used in electric ploughing service gives justification for grave uneasiness. It is true that such connections have been used for years past in Germany and Italy, but the aim in view is to devise equipment which will give a high degree of reliability and safety when used by agricultural labourers, from whom it is useless—if not actually unreasonable—to expect observation of even the most elementary precautions. To put the matter on no higher plane, the progress of electricity in agriculture will be delayed and compromised by even a few accidents.

Complete security is obtained by arranging that the tapping connection cannot be made or broken whilst under pressure. This condition is fulfilled by equipment devised by M. A. Delamarre, and described by the inventor in a recent issue of the *Revue Générale de l'Electricité*. The first set, designed for pressures from 12,000 to 15,000 volts or over, comprises a horn-type interrupter and a special type of plug and socket connection which can be closed and opened only when the interrupter is open. Referring to fig. 2, A represents the socket of the connector fixed on the post 2 or 3 m. below the line conductors, and connected to one of the latter by the lead L. A round rod T, mounted rigidly on the operating rod of the H.P. interrupter, covers the socket except when the isolating switch is open. The porcelain plug B, through which passes the conductor of the cable C leading to the transformer, is pierced by a hole O slightly larger in diameter than the rod T. The isolating switch being open, the socket A is uncovered, and the plug can be inserted. Then, on closing the isolating switch, the rod T passes through the hole in the plug and literally bolts the latter in position until the isolating switch is reopened.

Though the above equipment is perfectly satisfactory for pressures of 10,000 volts or higher, it is rather expensive for 3,000- to 5,000-volt circuits, and for the latter one may dispense with the H.P. isolating switch and use the type of switch illustrated in fig. 3, which is practically a standard type of knife switch with a modified lower jaw. The lead L from the overhead line is attached to the upper contact P. The lower contact is built in the form of a hook, and the switch blade is prolonged as shown. The lead passing to the transformer cabin terminates in a ring which can be placed on and removed from P' only when the switch is open. It will be seen that whilst this device is considerably simpler and cheaper than the one illustrated in fig. 2, it does not give the same high degree of security; neither does it ensure such satisfactory electrical contact.

Electric Ploughing.

In electric ploughing, as in tapping electricity supply from overhead lines, the primary problem is to adapt the electrical equipment to the special needs of agriculture. Having adapted the electric motor to the needs of the soil and to the habits of cultivators, it is then time to develop electric ploughing from the central station standpoint. The principal results of three years' study and experience of electric ploughing were presented by M. H. Guedeney to a meeting of the Société Française des Electriciens, on February 4th, 1920. The author has studied the working of various systems, both by inspection and by actual trial, and he has arrived at a combination of components which is claimed to meet the requirements of both farmers and central stations.

The main factors to be considered are: (1) Tractive effort and energy consumption for ploughing various soils. (2) Adaptation of equipment to the rough conditions and unskilled manipulation experienced in agricultural service. (3) Relative costs of electric ploughing and ploughing by other methods.

Power Requirements, &c.—According to the nature and condition of the soil the tractive effort required ranges from 30 kg. up to 100 kg., or more per sq. dm. From 400 to 1,200 kg. may have to be exerted to plough 15 cm. deep on a width of 1 m., and an effort of 1,200 to 4,000 kg. may be needed for twice that depth of ploughing. Certain tests, mentioned later, showed the energy consumption to be 180 KW.-hours per hectare when ploughing dry soil, and 75 KW.-hours per hectare when ploughing parts of the same field after rain. In order to allow for these variations, ploughs of different widths may be used. A limit is placed, however, upon the size of the plough by the weight of the blades, and by considerations of convenience in manipulation and uniformity of result. A 100-H.P. Fowler steam plough uses 1.2-m. blades for deep ploughing, and 1.8-m. for shallow ploughing, the pressure being 13 kg. per sq. cm. in the first case and often only 4 to 5 kg. per sq. cm. in shallow ploughing.

It follows that small sets of 30 to 50 H.P. have a higher average efficiency than more powerful sets, because they can be fitted with ploughs adapted to a wider range of conditions. In spite of the use of different ploughs, there are always large variations in effort to be overcome. The electric motor is capable of dealing with these, and allowance must be made for them in all parts of the equipment.

The conditions of service for plough motors are quite as severe as those for traction motors. The motor is used in the open with more or less incomplete protection against weather. The machine becomes hot whilst at work during the day, but, during the night, it becomes covered with dew, and it is set to work again whilst in that state. It is started and stopped about every 10 minutes, and overloads are severe. Rugged mechanical construction and low working voltage are necessary, especially because it is rarely possible to earth the winch or transformer cabin satisfactorily. The author mentions a case in which the motor broke down to frame and the plough seat became live through the towing cable. The driver quitted his post with alacrity.

The Labour Problem.—The agricultural worker is accustomed to performing eight or ten different operations on four or five crops per annum, and he is accustomed also to long working hours and the other rigours of farm life. None of these things may be said of the skilled mechanic or electrician, who is not, moreover, usually interested in agricultural matters. For all of these reasons, it is very desirable that electrical equipment for use on farms should not demand the services of skilled mechanics or electricians. The electric motor itself can be driven by a woman or by a disabled man, and it remains only to make the rest of the equipment equally simple.

Lightness is Important.—It is obviously desirable that the ploughing equipment be as light as possible, and it is one of the principal disadvantages of tractors that they compress the soil as a preliminary to cultivating it. Even the hooves of animals produce small blocks of compressed earth which remain sterile for a long time. Steam ploughing on the cable system is free from this objection, but the heavy equipment compresses broad tracks, and involves comparatively wide headlands. The lighter the equipment, the less the inconvenience

caused by its sinking in the soil, but, on the other hand, the greater the care required to secure stable anchorage for winches, &c. Given an equipment which can be used without compressing the soil, it may be used with advantage in harrowing, rolling, and sowing.

Commercial and Technical Desiderata.—It is essential that the ploughing equipment should be reasonably cheap, *i.e.*, it should be within the purchasing powers of the farmer of 150 to 200 hectares or that of a group of three or four small farmers. If the cost be so high that a large co-operative group is required, too much time is lost in transferring the equipment from one farm to another, and some of the members are kept waiting. Depreciation must be so low that the annual charges on capital are reasonable.

From the central station point of view, the desiderata are reasonable power factor; suppression or damping of peak loads; and good load factor. A set of 30 to 50 H.P. can, for reasons explained above, always be operated at near full load, and therefore at good power factor. Also, four 30-H.P. sets yield a more nearly uniform load than a single 120-H.P. motor. Finally, a light equipment of moderate power can be used economically for other cultivating operations besides ploughing, and this is to the advantage of the farmer.

(To be continued.)

ELECTRICITY IN FACTORIES.

Report of H.M. Electrical Inspector of Factories.

The annual report of the Chief Inspector of Factories and Workshops for the year 1919 has just come to hand.* The use of electricity in factories is reported on by Mr. G. Scott Ram, M.I.E.E., who last year gave an account of the most noticeable developments in the use of electricity during the previous four years, covering the period of the war. During the past 12 months he has discovered little in the way of novelty to chronicle. The most important fact is that the expansion in the use of electrical energy for all kinds of purposes, which received such an impetus during and on account of the war, continues unabated now that the driving power of war emergency has been replaced by purely industrial activity. Evidence of this continued progress is apparent in all branches of electrical work.

The demand for supplies for power purposes is far in excess of the present capacity of the public supply stations in many districts. This result is partly attributable to the high price of coal and uncertainty as to its delivery. Many factory occupiers, particularly mill owners in the woollen and cotton districts, who before the war could not be persuaded to adopt electrical driving, are now clamouring for it, and appear aggrieved that they cannot obtain supplies of electrical energy all at once. The effect on the supply undertakings is that many are overloaded and working without any reserve of plant. The difficulties are increased in many instances owing to the inferior quality of the coal obtainable, resulting in diminished steam-raising capacity. In some districts relief has been sought, by electrically linking up different supply undertakings. This has no doubt permitted of a larger combined output, but the margin having been rapidly overtaken, the situation as regards overload and shortage of plant remains uneased thereby. Numerous extensions of generating stations are in progress, and schemes for new "super-stations" are under consideration. Two new public supply generating stations of large capacity and on the most modern lines have been completed during the year, and are about to be put into operation.

The number of accidents reported during the year was 390, of which 28 were fatal. Owing to incomplete returns during the war period, comparison with the figures for the last few years is useless. Compared with 1914 and 1913, the total is less, the figures for those years being 450 and 512 respectively. The fatal cases are, however, greater, being 28, as against 20 in each of those years. The reduction in the total is satisfactory in view of the enormously wider use of electrical energy compared with that in the earlier years.

The fatalities were, with one exception, all from alternating current; 20 out of 28 were at low pressure, *i.e.*, not exceeding about 250 volts. With two or three doubtful exceptions, the shock was in all cases from one phase to earth. As most of the systems had the neutral point earthed, the shock could not, therefore, have exceeded low pressure. In seven of them the shock was received from lighting circuits connected between phase and neutral. This once more emphasises the fact, which has been repeatedly pointed out in previous reports, that a shock from A.C. at low pressures is vastly more dangerous than with D.C., although Mr. Ram finds that the contrary idea is widely held. This matter needs bearing in mind at the present time when there is so much talk about cheaper methods of wiring. The process of cheapening often begins by eliminating safeguards. Whether for factory or any other premises, where A.C. is used, the cheapening process should not be allowed to introduce any unnecessary risk of shock.

There is nothing unusual in the nature of the fatalities, similar ones have been described at length in many of the previous reports. Eight were from contact with the necessarily bare wires of overhead cranes or other travelling machines. Two were from hand lamps, one being the old type of hand lamp wherein the wire cage is attached to the lampholder. The other was just an ordinary metal lampholder attached to flexible wires. The latter arrangement is so readily rigged up that it is often used, even where safety types of handlamps are provided, but are perhaps not at hand at the moment. Two were due to current being switched on while persons were working on the circuit, the switches not being locked off nor any warning notice attached to them. Three, including two at high pressures, were in the testing departments of electrical manufacturing works. One of these was due to a mistake in switching. The other was due to a quite unnecessary and dangerous practice sometimes adopted in cable works. It appears that inspectors on behalf of the purchasers of cable, when attending H.P. tests of the cables, are not prepared to accept the cable maker's assurance that the pressure is actually being applied to the cable, and require an ocular demonstration of the fact by means of a flash, which is produced by short-circuiting the cable core to the lead sheathing. In this case a man entered the fenced-off danger zone to make the flash with a pair of insulated tongs, and came into contact with the H.P. connecting wires. It would appear that such demonstrations are not really necessary at all, but if required, they could be quite well arranged without any one having to enter the danger zone.

One fatality, of an unusual character, was reported. A man had used a metal lampholder as a portable lamp on a 240-volt D.C. circuit. The holder became live; he received a prolonged shock, and was severely burned in the hand. He died 16 months later from paralysis, attributable, according to the medical evidence, to the injuries he had received.

Amongst the non-fatal accidents, several occurred on E.H.P. systems. Five occurred to skilled persons, due to their own mistakes. In two cases they had forgotten to pull out the isolating switches protecting the oil switches on which they intended to work. In two others, where it was intended to earth dead conductors before working on them, live conductors were put to earth. Isolating switches were also operated in error whilst current was flowing. In five cases, unskilled persons were put to clean switchgear wthout proper supervision. Having completed the work they were instructed to do on dead portions of the switchgear, they proceeded without instructions to clean other parts which were live. These accidents again show the necessity for continuous supervision, unless all dangerous conductors are in locked cells. One accident in which two men were severely burned was due to the faulty arrangement of an isolating switch, whereby it was able to fall into contact after being switched off.

One accident was due to the use of a spanner on a H.P. switchboard close to unscreened conductors, and several others were caused by similar foolhardiness of persons when working on medium-pressure switchboards. Totally ignorant persons are always liable to be a source of danger to themselves and others when employed in electrical stations, unless under strict supervision. There seems to be no limit to the extraordinary things they may do. Thus, a boy was employed to assist a fitter in the engine room of a large power station. He was told to connect up a portable 200-volt drill. Instead of seeking the nearest plug provided for the purpose, he climbed a ladder on to the switch gallery, got over a rail and entered a passageway of E.H.P. cells protected in front by screens 8 ft. high. He appears to have climbed a screen and attempted to connect the flexible lead to a 10,000-volt conductor. He was lucky in getting off with severe burns.

Three accidents were due to the explosion of oil switches, causing injuries from burns from the ignited oil.

One accident was due to a local inflammation of gases from secondary cells in a battery room. The ignition was caused by a man entering the room with a lighted cigarette. The battery room was faulty, in that there was practically no ventilation.

In his inspections Mr. Ram found many examples of bad and dangerous work. These are by no means confined to factories where the occupier may have no technical knowledge, but occur also in electrical generating and sub-stations of public supply undertakings; *e.g.*, exposure of H.P. conductors within reach, not only in switchboard passageways, but also in other parts of the premises accessible to anyone; potential transformers connected direct to the main busbars, without any isolating switches; open type alternating medium pressure switchboards with working platforms of iron plates without insulating mats. In some of the older stations which have been extended with good modern plant, old switchboards entirely unfitted for the present greatly increased power are retained in use. Occupiers of factories are often entirely dependent upon the contractors for putting in good plant in a proper manner. Even where good apparatus is supplied, dangers are often introduced through ignorance. Thus, a number of cases were found where inter-locked switch and fuse boxes were provided, the intention being that the fuse boxes could only be opened for renewal of the fuses when dead, but, in fact, they were connected the wrong way round so that the fuses would be always live and the interlock of no use.

Several prosecutions were taken for breaches of the Electricity Regulations, and penalties varying from £2 to £50 were imposed.

* H.M. Stationery Office, Kingsway, W.C. 2. Cmd. 941; price 1s. 6d. net.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Universal Vice Jaw.

The Allan & Magowan universal vice attachment fits any vice and grips practically all shapes. The attachment is a supplementary vice jaw which adapts itself to any shape or form of material, whether oblong, cylindrical, hexagonal, or polygonal. The jaw is a master jig—it will hold anything, and is a time and labour saver. It elimates the need for special jigs, moulds, and forms, for holding irregular castings, tapers, ovals, rounds, &c., and it exerts a complete equalisation of pressure on all forms, and gives a 100 per cent. gripping surface. The attachment is ready for use instantly, it stays in place by its own weight, and when finished with it is simply lifted off and laid aside. It is strong and simple, and is made of cold rolled tempered tool steel, electrically welded. It is made in three sizes, 4 in., 5 in., and 6 in. All mechanics know how extremely difficult it is to hold a connecting rod securely in any vice. A connecting rod has a tapering surface and a vice has not, but holding such a rod is an easy task for this vice attachment, because of its adaptable teeth. It grips the taper instantly. One feature alone, the grip for cutting threads, is invaluable. The attachment gives this grip, and makes it easy to do tapping, thread cutting, reaming, loosening rusted connections, assembling threaded parts, and many other operations that require a pipe-vice grip. With the attachment a small round or flat-headed screw may be securely held in

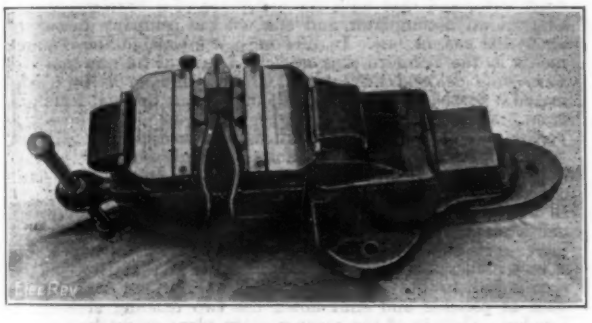

Fig. 1.—Universal Vice Jaw.

position for threading, filing, cutting off, or any other operation; the screw may be held in either a vertical or horizontal position. For holding rounds, large or small, horizontal or perpendicular, the attachment finds its field. A 4-in. piston would not fare very well in the ordinary "V" block generally used for holding rounds, but with the use of the attachment the points of contact distribute the holding pressure evenly over almost one half of the circular surface. The universal vice jaw presents a solid, firm, and rigid steel surface, with the flexibility of rubber, all due to the independent action of each gripper in adjusting itself to the contour of any possible shape of material, no matter how irregular. Slipping is entirely eliminated. Fig. 1 shows a pair of pliers being held as securely as in any jig; note the numerous points of contact, each one bearing the same amount of pressure. Messrs. Alfred Herbert, Ltd., Coventry, are placing the device on the market on behalf of the manufacturers, Messrs. Allan & Magowan, of Follokshields, Glasgow.

A New Sparking Plug.

A sparking plug of novel design, which can be removed from the engine without its being necessary to stop the latter, and without the use of tools, is described in the *Commercial Motor*. To enable this to be done, the plug is slightly altered from standard design so that it may fit into an adaptor screwed into the usual sparking plug thread. The adaptor is provided with a hexagon so that it can be screwed into the cylinder with a spanner in the ordinary way. The bore of the adaptor has three inward projections, which engage bayonet slots in the plug proper. Once installed, the adaptor becomes practically a part of the cylinder, and is not removed. The bayonets on the plug are formed at an angle so that the plug is pressed on to a copper-asbestos gasket contained within the adaptor. The upper end of the plug boss is provided with a large flange of material, non-conducting as regards both electricity and heat. The flange is knurled on its outer edge. To prevent the plug becoming loose in the adaptor, serrations are formed round the top of the latter, and a small serrated key on the plug is brought into mesh with the serrations on the adaptor by means of a small locking screw which holds the plug firmly. The complete plug will shortly be placed on the market by the Instanto Plug Co., 307, London Road, Westcliff-on-Sea.

High-pressure Insulators.

Disk suspension insulators of remarkable qualities are made by the Jeffrey-Dewitt Insulator Co., of Huntington, W. Va., U.S.A. They consist of *thick* porcelain disks, which are in tension, and are made without the use of cement. The accompanying sections, figs. 2 & 3, show insulators 11 in. in diameter and 4½ in. thick, the least dielectric thickness being 2¼ in. The dielectric strength of each disk at 60 cycles is 300,000 volts, and at 200,000 cycles 250,000 volts; the dry flash-over voltage of one disk is 97,000 volts, and of three disks in series 253,000

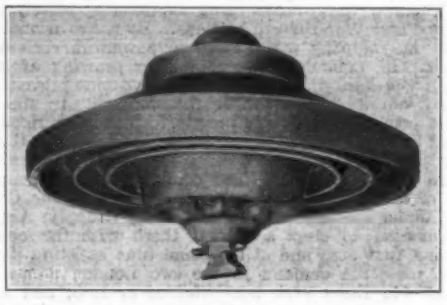

Fig. 2.—J.-D. Insulator.

volts, the corresponding figures in the wet test beinb 47,000 volts and 139,000 volts. The guaranteed ultimate strength of the insulator is 8,000 lb., but the average is 9,500 lb. The spiders are of galvanised steel, and are fixed into the insulators with a special alloy. It is claimed that these insulators are permanently safe against puncture, are not destroyed by intense power arcs across the string, and are proof against bullets and moisture. These properties are secured by scien-

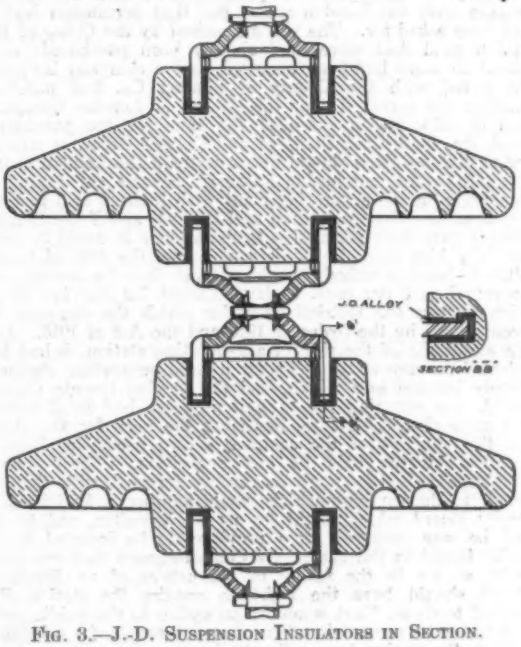

Fig. 3.—J.-D. Suspension Insulators in Section.

tific preparation of the raw materials, and firing the insulators in a continuous tunnel kiln, which is traversed by an insulator in 3¾ days, and is heated by natural gas under accurate temperature control. The porcelain is tested for porosity by the fuchsine penetration test devised by the company in 1917, under a pressure of 200 lb. per sq. in.

Besides the suspension type, insulators are made with flanged connections, enabling them to be bolted together rigidly as columns for use in out-door switchgear, for carrying busbars, &c.

ELECTRICITY SUPPLY IN LONDON.

Inquiry Held by the Electricity Commissioners.

An inquiry was held at the Westminster Guildhall on October 6, 7, 8 and 9 by the Electricity Commissioners into an application by the County of London Electric Supply Co., Ltd., to build an electric power station at Barking under the terms of its Provisional Order of 1913. The issues involved necessitated many of the factors concerning the London Electricity Supply problem as a whole being gone into. The Commissioners were Sir John Snell, Sir H. Haward and Mr. H. Booth.

The County of London Electric Supply Co., Ltd., was represented by Mr. H. Lloyd, K.C., and Mr. Tylor, whilst the London County Council, 38 local authorities, and nine companies, which opposed, were represented by Mr. Tyldesley Jones, K.C., and Mr. Kennedy.

On Wednesday, October 6th, Mr. H. Lloyd, K.C., in presenting the case for the County of London Co., emphasised the very serious position in which the company now found itself. It had two areas of supply, one north and one south of the River Thames, these areas being served respectively by the City Road and Wandsworth stations. By a Provisional Order of 1913, the company was also given powers in certain areas in Essex. In London the demand was growing at a rapid rate, but the limitations of the power stations prevented the necessary development to meet the demand. In the Essex area the company had been unable to make a serious start, and had been compelled to limit its operations to the compulsory area by making an arrangement with a private firm to afford a small supply. The company had no generating station of its own in that area, and now asked the Commissioners, under the terms of the Electricity (Supply) Act, 1919, for permission to erect a station there with the object of developing that area and at the same time assisting the company to meet the demand in the two London areas. The Order for the Essex area was obtained in 1913, and but for the war would have been carried out by now, and could not have been opposed, but under the Electricity Act, 1919, it was now necessary to obtain the consent of the Electricity Commissioners. Under the Order of 1913, it was provided that the provisions of the Electric Lighting Act, 1908, with regard to linking-up with other stations should only be applied subject to the consent of the Board of Trade. The proposed station was not only to supply the Essex area, but also to assist the supply in the London areas; moreover, the station had been planned so that it could be extended hereafter in order to deal with a much greater supply if thought necessary. Technically, therefore, he would have to apply to the Ministry of Transport for permission to link up the new station with the London areas, but that permission had not yet been asked for. The site authorised by the Order of 1913, and a good deal more, had already been purchased; in all about 90 acres had been acquired, and a company intimately connected with the County of London Co. had purchased another 300 acres. Under the County of London Company's Act of 1918, which extended the time for the purchase of land, &c., under the Romford and District Order, it was provided that no claim should be made upon the London County Council as the purchasing authority beyond the capital expenditure on the generating plant with interest at 6 per cent. per annum. That restriction still applied, and if the Commissioners gave their permission to the scheme it would be necessary for him to go to Parliament to get the rate of interest altered, because nobody would suggest that the money could be raised at 6 per cent. to-day. Except for that he did not wish to vary the restrictions under which the company had been placed by the Order of 1913 and the Act of 1918. As to the suitability of the site for a generating station, it had been selected on several occasions for a large generating station to supply London as a whole, and the London County Council, which was opposing the present proposal, had itself selected the same site. Therefore, assuming the need for the station for the purposes of the company's own needs, he failed to see why there could be any opposition. The County of London Co. had no wish in coming forward with this proposal, to do anything which would hamper a District Electricity Board which might be set up hereafter, and to that end he was prepared for a provision to be inserted in any Order issued by the Electricity Commissioners that any public body set up in the future in the nature of an Electricity Board should have the right to acquire the station if it desired to do so. That would be an option to the public authority and not a compulsion. The company expected a substantial load on the station from railways, because the area was bound to develop enormously, and there was no doubt that tramways or motor omnibuses could not deal adequately with the traffic. He was prepared to submit the plans to the Commissioners so that they could arrange for the station to be constructed in such a manner that extensions could be made to meet future requirements.

Mr. C. P. Sparks, chief engineer to the County of London Co. until December, 1919, when he retired, was then called.

Sir John Snell asked that the evidence should be confined to the growth of the company and its future prospects.

Mr. Sparks said that both the London stations of the company were limited in output by the condensing-water facilities. Under the most favourable circumstances the maximum output at the City Road works was 10,000 kw. and at the Wandsworth works 20,000 kw., making a total of 30,000 kw. A new 6,000-kw. generating set was being erected at Wandsworth, but before that was decided upon he had advised his company to purchase in bulk from the City of London Electric Lighting Co., Ltd. A contract was entered into for 5,000 kw., to be increased eventually to 10,000 kw., but although that supply was due in the early part of this year, none had yet been given, and none was likely, as the City Co. could not get the necessary plant. It was in consequence of that that the company decided to install a new generating set at Wandsworth, which it did not want to do owing to lack of condensing water. Witness exhibited a curve showing the progress of the County of London Co. from 1909 to 1919. There had been a gradual increase up to the outbreak of war, and then there was a definite drop for several years. Since the armistice, however, there had been a very rapid improvement, and at the end of 1919 the output was 26,000 kw. Estimating on a lower rate of growth than that for the next four years, he calculated that the company would be called upon to provide a total of 40,000 kw. in the existing London area in four years' time, but even that took no account of important business coming along in the way of bulk supplies. In the past the company had been hampered on several occasions because it had not sufficient plant to enable it even to negotiate for such supplies. The South London Electric Supply Corporation, Ltd., and the Post Office had both wanted large supplies, but they could not even be considered. Under the Romford Order of 1913, only the compulsory area had been dealt with, and that with the assistance of a brewery, which charged an accumulator and enabled the company to supply about 100 kw. or less. In 1914 he had estimated the requirements in the Romford area at 8,500 kw., but he now put the immediate demand there at 10,000 kw., and by 1924 he estimated a total load of 50,000 kw. in the London and Romford areas. The new station was urgently required to relieve the present London generating stations, because the difficulty of running the older London stations was increasing every year, quite apart from the question of greater efficiency in coal consumption. At the City Road station some of the plant was 13 to 15 years old, and at the Wandsworth power house the oldest plant was 14 and 15 years old. He estimated 14,000 kw. increase in the London area in the next four years, which was a very moderate estimate. He was satisfied that it would be economical to get the new station at Barking running as soon as possible and shut down the two existing stations in London. Certain of the more modern plant might be held in reserve for some years in both stations; the City Road station would be dismantled first and Wandsworth run for a little longer. He calculated that it would be 3½ to 4 years before the present position could be relieved, even if the new station was started at once.

Cross-examined by Mr. Tyldesley Jones, Mr. Sparks said that the first section of the generating station would have a capacity of 200,000 kw., but it was capable of extension to 600,000 kw. In the first place it was proposed to put down three alternators of upwards of 20,000-kw. each. The site in question was the same as that scheduled by the Administrative County of London Power Co., which was promoted by Mr. Merz some years ago. The 200,000-kw. station would eventually contain eight sets of 25,000-kw. each or thereabouts. Probably the actual size would be between 30,000 and 33,000 kw. each, but in any case the plans would have to be submitted to the Commissioners. The total cost of the first section of 60,000 kw. was estimated at £4,500,000, of which the power house would cost £2,678,000; certain charges would have to be added for interest during construction. The main transmission lines were estimated to cost £507,000, these including the mains necessary to link up with the company's existing power houses; the transmission and distribution system in the Romford area would cost £375,000, and interest during construction at 10 per cent. would cost £404,000. The figures for the main transmission lines included substations. The generated pressure would be stepped up to 40,000 volts. He put the cost of transmission at £0.7 per kw. per mile on the average. In the figures of output which he had given were the present bulk supplies to the South London Electric Supply Corporation, Ltd., the South Metropolitan Electric Tramways and Lighting Co., Ltd., and to a company operating in the area around Chipstead. The Bankside station of the City Co. could be extended to 100,000 kw., but it would be impossible to work it on account of difficulties with coal storage. Those difficulties were bad enough with an output of 36,000 kw. With regard to the bulk supply now given to the South London Electric Supply Corporation, Ltd., of which the County Co. held all the shares, he would shut that station down as soon as Barking was running.

Mr. Tyldesley Jones added that the present arrangements of the City Co. were that three additional 10,000-kw. sets were

to be installed, making a total capacity of 66,000 KW. at Bankside. Moreover, the South Metropolitan Electric Light and Power Co., Ltd., had a large power station with power available. He contended that it would be possible to obtain all the power which the County Co. needed during the next two or three years without constructing the Barking station. The construction of that station by the County Co. might very well prejudice the preparation of the large scheme in the near future.

Mr. SPARKS said that the total area of supply under the Romford Order was about 130 sq. miles. He would not advise his company to purchase power from the City Co., because he could not regard such a supply as reliable.

Mr. C. H. MERZ, who acted as consulting engineer to the County Co. in conjunction with Mr. Sparks, said he considered the estimates of growth already given were on a most conservative basis, but that course had been adopted in an endeavour to ensure a uniformity of prosperity of the company. It would take one year to get going after the consent was obtained, two years of active construction, and one year for tuning up. He failed to see that the construction of the station would in any way prejudice the subsequent operations of an Electricity Board, if one was established; indeed, it should facilitate those operations. There was a large prospective railway demand, and it was necessary to prepare for that; it was no use saying to a railway company that they would begin to prepare to meet a demand if a contract was given. Contracts for railway supply were never given on that basis. Cross-examined, Mr. Merz agreed that the company's undertaking would be purchasable in 1931, and that that would only leave seven years for the full operation of Barking before purchase took place either by the London County Council or some other body. Notwithstanding that, there would not be any difficulty in getting the necessary capital to construct the Barking station. He maintained that a load of 50,000 KW., as contemplated in 1924, would give sufficient revenue to provide an adequate return on the 4¼ millions sterling new capital and the existing two millions capital of the County Co. In the case of the North-east Coast power companies 8 per cent. was paid on the ordinary shares with a capital of five millions sterling and a load of 112,000 KW., but, added Mr. Merz, the price was very low on the North-east Coast. People like those who were opposing this application did not want to see electricity developed. The other London companies wanted to be left alone or bought out. There was nothing experimental about a 33,000-KW. turbo-alternator running at 1,500 R.P.M.; a 20,000-KW. machine running at 2,000 or 3,000 R.P.M. was a much more difficult problem. It was agreed that Mr. Merz should prepare an estimate, not in too great detail, in support of the proposition on the question of cost of generation at Barking.

Mr. TYLDESLEY JONES said that there was no urgency which made it necessary for them to do anything to prejudice the inquiry which would take place by the Commissioners as soon as possible after March 31st, 1921, when the Commissioners would consider the area for London electricity supply, which had already been provisionally drawn up, and schemes for dealing with that area. That area would undoubtedly include the Barking area, and to give permission to the County Co. to proceed with a station there would be to prejudge the larger question to be considered next year, for his clients were preparing a scheme for submission at that inquiry.

Sir HARRY RENWICK, deputy chairman and managing director of the County of London Co., said that but for the war the Barking station could have been erected and no one could have opposed it. There was no desire in coming forward now to prejudice any larger scheme; he only wanted to be able to supply his own needs. Certainly there was no other scheme so far as he was concerned, and it so happened that his engineers in getting out their plans extended them to show that 600,000 KW. could be accommodated on the site of the power station if necessary ultimately. Such an extension, however, was in the hands of the Commissioners. He was only concerned with the first instalment of the power station. The Lower Thames Development Co. was formed during the war in order to buy land for the generating station, as the Treasury objected to the County Co., a statutory concern, spending money for that purpose at that time. The land had been since purchased from the Development Co., in which the County Co. held all the shares.

On Thursday, October 7th, Sir HARRY RENWICK was cross-examined. He was not prepared to go into the question whether the Development Co. made a profit on the land which the County Co. bought from it. The price paid was on an independent valuation by Sir Alexander Stenning. Sir H. Renwick said that when the sanction of the Commissioners to go ahead with the station was obtained, there would be no difficulty in persuading the financial people to support the scheme.

Mr. JONES referred to a conference called by the Electricity Commissioners a short time ago when a suggestion was made that all the electricity supply authorities in London should come together and endeavour to prepare a scheme for dealing with the electricity supply to the London district. Since then an offer had been made to the County Co. by the others to join in such a scheme, but the County Co. had declined. Sir H. RENWICK said he had never declined to join any such combination of authorities; he had never been invited. If he knew that the London County Council and the companies had a really constructive programme he would join them at once. Counsel put it that the County of London Co. had refused to join the others unless the Barking site was taken over by them. Sir H. RENWICK said that he personally had made no such statement; he believed the chairman of his company, Sir Ernest Hiley, had reported to the Board in favour of that course, but he himself did not agree with it. Unless something was done, and done at once, he was no longer prepared to take the responsibility for working the County Co., and unless a decision was given soon he would have to call his shareholders together, let them know the facts, and ask them to relieve him of that responsibility. Unless somebody would come forward and guarantee him 100,000 KW. to carry on his business he was not prepared to continue the responsibility. The London companies had been obstructive all along the line.

The CHAIRMAN, interposing, said the Commissioners desired to call the chairman of the County Co. He pointed out that when the City Co. had its three 10,000-KW. turbo-alternators installed, that would give a considerable accession of power to the County Co. Sir H. RENWICK agreed that in that way he could get a supply during the next two or three years, but he wished to develop along proper lines. He had asked for 100,000 KW. because he believed the estimates of his engineers were too conservative and would be doubled or trebled if the plant was available to supply the power. He had not been able for years past to deal with business which had been offered him because he could not see the possibility of supplying it whilst he was baulked in developing Barking. Moreover, whatever supplies he got from the City Co. would not help him to develop the large area in Essex. Croydon, Shoreditch, and Barking had asked him for supplies, but he had not been able to give them. In the case of Croydon they wanted 5,000 KW., whereas he was only able to give 1,000 KW. Wimbledon had also asked for a supply, but had had to be refused.

The CHAIRMAN pointed out that the units consumed per head of population per annum in the company's area were only 39.2, and the projected increase in the London areas of 14,000 KW. in four years would really represent a very small sale. Sir H. RENWICK repeated that he considered his engineers' estimates too conservative. He regarded the possibilities, even in the London area, as unlimited; there was a large quantity of land available for factories, and he anticipated an enormous industrial development.

Mr. C. H. MERZ, recalled, handed in the estimate asked for on the previous day, giving a comparison of the costs of extending the existing stations and of erecting the new station at Barking. Assuming that it was physically possible to extend the existing stations in London and to supply the Barking area from them, he proceeded on the basis of installing an additional 36,000 KW. at the City Road and Wandsworth stations. The generating plant would cost £1,060,000 on the same basis as that assumed for the generating plant at the Barking power station. He would lay two instead of five cables between London and Barking, and supply Barking from London instead of *vice versa*, and the total capital cost he put at £2,269,000, as against 4¼ millions sterling for the Barking power station. With regard to operating costs, however, there would be savings with the Barking power station of £212,000 on coal consumption by the year 1925, of £5,700 on the removal of ashes, and of £30,000 in operating costs, compared with the extension of the London stations, making a total of £248,000 in favour of the Barking scheme, and that saving would give a return of 11 per cent. on the capital expenditure involved in the London extensions. Moreover, the capital spent on the London stations would only have a useful life of four years, as it would then be necessary eventually to build the Barking station and, generally speaking, he held the view that any money spent on the London stations would only increase the financial burden on the undertaking. Taking into account the short life of the plant installed in the London works, the real saving by erecting the Barking station was much greater than he had shown, and would be nearer £500,000. The coal consumption of the Barking plant he estimated at 1¼ lb. per KW.-hour or 17,000 B.TH.U. Neither he nor Mr. Sparks would undertake to carry out the programme of alternative generation in the London stations, owing to lack of condensing water facilities at both of them.

This closed the case for the County of London Electric Supply Co., Ltd., in favour of the proposal.

Mr. TYLDESLEY JONES, addressing the Commissioners for the opposition, said that he represented not only the London County Council, which was the purchasing authority for all the London companies in 1931, including the County of London Electric Supply Co., Ltd., but also 16 Metropolitan boroughs owning electricity undertakings—the whole of such bodies—three county boroughs, viz., Croydon and East and West Ham, five borough councils, viz., Ealing, Gravesend, Hornsey, Kingston-on-Thames and Wimbledon, 14 urban districts owning electricity supply undertakings, and nine out of the 13 London companies. All these people offered the most strenuous opposition, not to a scheme at Barking, which might ultimately be approved by the Commissioners, but to consent being given now to the proposal of the County Co., at a time when schemes had been asked for to deal with the whole area on comprehensive lines which were to be adjudicated upon after March 31st, 1921, according to the notice issued by the Commissioners themselves. It was proposed to

spend 4½ millions sterling upon a 66,000-KW. station which could not, on the promoters' own showing, become operative for four years after they had got permission to go ahead, and by that time the County Co. would only have seven years' life left to it. The proposal was one of almost unparalleled magnitude for a London company, and if the case for the promoters was accepted it was a scheme to deal only with the domestic needs of the company. He reminded the Commissioners that in May of this year they called all the supply authorities in the London area together, and Sir John Snell, as the Chief Commissioner, had urged them to get together with a view to preparing a joint scheme. Practically everybody, with the exception of the County Co., acted on that advice, and a committee of engineers had been appointed, consisting of Sir Alexander Kennedy and Mr. G. W. Partridge, representing the companies; Mr. J. H. Rider, representing the London County Council; and Mr. C. H. Wordingham, representing the local authorities, had been hard at work preparing such a scheme for presentation to the Commissioners on March 31st, 1921. Now the Commissioners were asked to sanction a scheme, which involved the removal of the load from two London stations to a station at Romford, and this necessarily affected the whole of the deliberations of that technical committee. It had been said that no harm would be done because the County Co. was willing to be put under an obligation to sell the station to a joint electricity authority if one was set up hereafter, but the mere fact that the County Co. agreed to sell could not be binding upon an authority which was not in existence.

(To be concluded.)

NEW PATENTS APPLIED FOR, 1920.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by Messrs. Sefton-Jones, O'Dell and Stephens, Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

27,190. "Valve generators, &c." Radio Communication Co. and J. Scott-Taggart. September 24th.
27,191. "Electromagnetic wave systems, &c." Radio Communication Co. and J. Scott-Taggart. September 24th.
27,228. "Adjustable non-rigid coupling for magnetos, &c." W. W. Vinsen. September 24th.
27,238. "Switches for electric water heaters." J. F. Barr. September 24th.
27,242. "Electric heating devices." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. September 24th.
27,360. "Control devices for electric circuits." E. A. Watson. September 25th.
27,361. "Dynamo-electric machines." E. A. Watson. September 25th.
27,291. "Systems of generation of thermo dynamic and electrical power, &c." W. P. Durtnall. September 24th.
27,292. "Make-and-break devices for electric switches and fuses." Edison Swan Electric Co. and F. Shergold. September 24th.
27,325. "Insulated electric conductors or cables." G. C. Allingham. September 25th.
27,326. "Cap for sealing ends of insulated electric conductors or cables." G. C. Allingham. September 25th.
27,327. "Bonding and earthing connections." G. C. Allingham. September 25th.
27,329. "Sparking plugs." W. A. Clark and Sphinx Manufacturing Co. September 25th.
27,332. "Sparking plug." A. N. Drummond. September 25th.
27,339. "Starting and lighting systems for motor vehicles." H. M. Ainsworth. September 25th.
27,340. "Electric generating plant." D. D. Drury. September 25th.
27,349. "Insulation of electric conductors." F. Fernie. September 25th.
27,360. "Control devices for electric circuits." C. L. I. Manufacturing Co. and E. A. Watson. September 25th.
27,361. "Dynamo-electric machines." M.-L. Magneto Syndicate and E. A. Watson. September 25th.
27,380. "Electrical welding apparatus." C. E. Wood. September 25th.
27,393. "Amplifiers for sound-reproducing machines." J. W. Booth. September 27th.
27,411. "Devices for protecting low-tension electric circuits from abnormal charges." I. Guiducci. September 27th.
27,461. "Electrically-propelled boat." M. R. Loya. September 27th.
27,467. "Regulation of hydro-electric installations." W. L. Moore. September 27th.
27,477. "Electro-magnetic relays." Automatic Telephone Manufacturing Co. September 27th (U.S., December 31st, 1919.)
27,478. "Automatic telephone systems." Automatic Telephone Manufacturing Co. September 27th. (U.S., January 28th.)
27,490. "Miners' electric lamps." J. W. Jones and Thor Electric Safety Lamp Co. September 27th.
27,500. "Electric cells." E. C. van Slooten. September 28th. (Holland, October 27th, 1919.)
27,509. "Electric irons." G. H. Lofts. September 28th.
27,510. "Alloy for electric heating appliances." G. H. Lofts. September 28th.
27,522. "Automatic starting, regulating, or controlling switchgear." Electric Construction Co. September 28th.
27,553. Protective devices for alternating current electric distribution systems." British Thomson-Houston Co. and E. B. Wedmore. September 28th.
27,557. "Electrical switchgear." W. A. Coates, D. R. Davies, and Metropolitan-Vickers Electrical Co. September 28th.
27,558. "Electrical switchgear." D. R. Davies and Metropolitan-Vickers Electrical Co. September 28th.
27,561. "Thermal relays for electrical circuits." Metropolitan-Vickers Electrical Co. September 28th. (U.S., October 6th, 1919.)
27,572. "Alternating current generators." T. F. Wall. September 28th.
27,573. "Electrolysis." M. A. Adam and G. N. Antonoff. September 28th.
27,579. "Separators for elements of electric storage batteries." W. E. Holland and I. M. Skinner. September 28th. (U.S., May 17th, 1919.)
27,583. "Maintaining constant the periodicity of an alternating current." Ges. fur Drahtlose Telegraphie. September 28th. (Germany, September 29th, 1919.)
27,629. "Electrical condensers." E. A. Bayles and British Insulated & Helsby Cables, Ltd., and H. Higham. September 29th.
27,653. "Electric switches." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. September 29th.
27,658. "Sparking plugs." A. W. Armstrong. September 29th.
27,666. "Electrically etching, printing, reproduction, or relief plates." W. J. Mellersh-Jackson (Weeks' Photo Engraving Co.), and Weeks' Photo Engraving Co. September 29th.
27,672. "Bell, &c., indicator systems." A. J. Anido. September 29th.
27,692. "Trolley heads for electric vehicles." D. McColl and Shanghai Electric Construction Co. (McColl). September 29th.
27,709. "Electro-magnetic wave systems, &c." Radio Communication Co. and J. Scott-Taggart. September 30th.
27,727. "Electrodes." H. Plauson and W. P. Thompson (Plauson). September 30th.
27,728. "Automatic telephone systems." Automatic Telephone Manufacturing Co. and W. G. Taylor. September 30th.
27,729. "Mica cutting machine for commutators of armatures." C. E. Philo. September 30th.
27,748. "Telephone systems." Automatic Electric Co. and Automatic Telephone Manufacturing Co. (Automatic Electric Co.). September 30th.
27,755. "Telegraph keyboard perforator." A. C. Booth and A. S. Willmot. September 30th.
27,762. "Casings for electrical, &c., apparatus." British Thomson-Houston Co. (General Electric Co.) and General Electric Co. September 30th.
27,784. "Hand-operable dynamo electric machines." C. A. Nicolle. September 30th.
27,805. "Means for securing electric lighting machines, &c., for cycles, &c. R. Bosch Akt.-Ges. September 30th. (Germany, October 2nd, 1919.)
27,809. "Mouthpieces of telephones." E. L. Mann and Phonopore Construction Co. September 30th.
27,814. "Electric reading-lamps, &c." C. O. Green. October 1st.
27,830. "Mine signalling apparatus." Clay Cross Co., and J. W. Strong. October 1st.
27,831. "Rotors of electric induction motors." J. W. Atkinson. October 1st.
27,876. "Telephone transmitters." R. L. Murray and Telephone Manufacturing Co. October 1st.
27,880. "Ignition systems for motor cars." W. Cooper. October 1st.
27,888. "Wireless apparatus." P. Alexander and C. W. C. Beckmann. October 1st.
27,909. "Electrical switching, &c., mechanism." Cutter Electrical and Manufacturing Co. October 1st. (U.S., October 2nd, 1919.)
27,917. "Electrical switching, &c., mechanism." Cutter Electrical and Manufacturing Co. October 1st. (U.S., December 24th, 1919.)
27,956. "Sheet metal clips for earthing electric cable conduits." E. Hanff. October 2nd.
27,964. "Alloy for electrical make-and-break contacts." W. D. Meagher. October 2nd.
27,984. "Electric apparatus for waving the hair." G. Boudou. October 2nd. (France, March 26th.)
27,991. "Testing electric cables." P. Dunsheath and Henley's Telegraph Works Co., W.T. October 2nd.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1918.

5,455. "Winding with equi-potential connections for drum-armatures of electric commutator machines." E. C. R. Marks (Akt.-Ges. Brown, Boveri, et Cie). January 9th, 1918. (150,752.)
16,806. "Methods of and apparatus for electric welding." British Thomson-Houston Co. (General Electric Co.). October 15th, 1918. (150,756.)
21,897. "Construction of magneto-electric machines." G. M. Turner. June 17th, 1919. (150,757.)

1919.

10,618. "Material for electric brushes." A. E. White (Becker Bros.). April 29th, 1919. (150,765.)
11,086. "Method of indicating, locating, and isolating faults in electric-transmission or distributing systems." Ateliers De Construction Oerlikon, P. Dawson, F. W. Fawdry, P. Luder, and G. Wuthrich. May 3rd, 1919. (150,766.)
13,029. "Electrodes for electric primary cells and storage batteries, and a process of making such electrodes." Svenska Ackumulator Aktiebolaget Junger. June 13th, 1918. (128,197.)
14,192. "Electric furnaces." L. W. Wild and E. P. Barfield. June 4th, 1919. (150,793.)
14,309. "Wireless signalling systems." British Thomson-Houston Co. (General Electric Co.). June 5th, 1919. (150,798.)
14,462. "Negative plate for electric batteries and process for making it." A. Pouchain. June 6th, 1919. (150,810.)
14,463. "Negative plate for electric accumulators and process for making it." A. Pouchain. June 6th, 1919. (150,811.)
14,545. "Attachment for electric lamp holders in motor lamps and the like." O. T. Banks. June 7th, 1919. (150,818.)
14,668. "Dynamo electric machines, and means for controlling the operation thereof." L. J. Stephenson. June 20th, 1918. (128,556.)
14,682. "Apparatus for converting alternating electric currents into direct currents, and vice versa." J. E. Calverley and W. E. Highfield. June 10th, 1919. (150,824.)
14,683. "Apparatus for converting alternating electric currents into direct currents, and vice versa." J. E. Calverley and W. E. Highfield. June 10th, 1919. (150,825.)
15,205. "Processes of making nitric acid." British Thomson-Houston Co. (General Electric Co.). June 17th, 1919. (150,836.)
15,610. "Electric water heaters." J. F. Barr. June 20th, 1919. (150,845.)
15,770. "Electric dry cell batteries." H. R. Palmer. June 23rd, 1919. (150,848.)
16,134. "Electric storage battery separators." H. L. Boyer. June 26th, 1919. (150,853.)
16,353. "Electric fittings known as double-ended lamp holders." Efandem Co. and W. Owen. June 30th, 1919. (150,857.)
17,480. "Electric display sign." C. Tregoning. July 12th, 1919. (150,870.)
18,127. "Dry cell batteries." H. R. Palmer. July 21st, 1919. (150,876.)
18,613. "Hand-operated electric switches." E. Mepsted. July 26th, 1919. (150,878.)
18,683. "Thermostatic valve units." British Thomson-Houston Co. (General Electric Co.). July 28th, 1919. (150,879.)
23,979. "Wireless telephone apparatus." P. L. Douvry. September 30th, 1919. (150,907.)
24,368. "Electro-mechanical variable-speed and reversing mechanisms." Anciens Etablissements Barbier, Benard and Turenne, and E. Granat. October 6th, 1919. (150,908.)
29,909. "Methods of starting and braking electric motors." C. J. Belli. December 13th, 1918. (136,537.)

1920.

7,163. "Automatic switch for electric heating appliances." B. G. C. Stephens. March 9th, 1920. (150,951.)
10,512. "Electric telephones." H. P. Rees. April 15th, 1920. (150,956.)